



(11)

EP 4 361 074 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

01.05.2024 Bulletin 2024/18

(51) International Patent Classification (IPC):

B65H 49/16 (2006.01) **B65H 54/26** (2006.01)
B65H 57/22 (2006.01)

(21) Application number: **23205534.3**

(52) Cooperative Patent Classification (CPC):

B65H 57/22; B65H 49/16; B65H 54/26;
B65H 2701/31

(22) Date of filing: **24.10.2023**

(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 ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA

Designated Validation States:

KH MA MD TN

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(30) Priority: **24.10.2022 JP 2022170223**

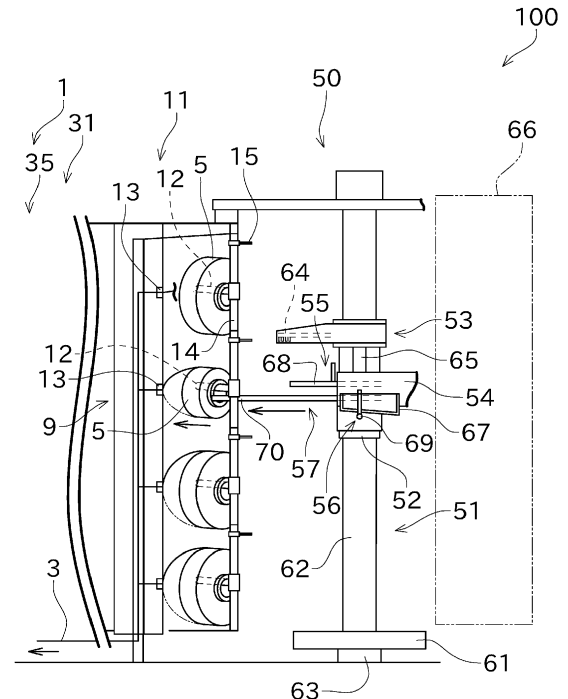
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(54) **YARN PROCESSING SYSTEM AND WORK ROBOT**

(57) [Problem to be solved] To ensure stable and smooth unwinding of yarn from the yarn supply package.

[Solution] A drawing and false twisting machine 1 includes a peg 12 on which a yarn supply package 5 wound with yarn 3, which is POY, can be set; a processing position 35 where the yarn 3 from the yarn supply package 5 set on the peg 12 is processed to form a wind package; and a yarn guide that guides the yarn 3 toward the processing position 35 at a downstream end of a balloon formed by the yarn 3 unwound from the yarn supply package 5 set on the peg 12. The yarn supply cart 50 is a work robot that performs work for the drawing and false twisting machine 1. The yarn supply cart 50 includes a yarn supply package position adjustment device 57 that moves at least one of the yarn supply package 5 from which the yarn 3 is being unwound and the yarn guide 13 to decrease the distance between the yarn supply package 5 and the yarn guide 13 as the unwinding of the yarn 3 from the yarn supply package 5 progresses.

FIG. 6



EP 4 361 074 A1

Description

TECHNICAL FIELD

[0001] This invention relates to a yarn processing system and a work robot that performs work for a yarn processing machine.

BACKGROUND ART

[0002] PTL 1 discloses a drawing and false twisting machine which is a type of yarn processing machine.

[0003] The drawing and false twisting machine of PTL 1 is equipped with a false twisting device and a creel. The creel is equipped with a peg to which a yarn supply package can be attached. A yarn supply cart that can travel along the creel is provided separately from the drawing and false twisting machine. The yarn supply cart is capable of removing a yarn supply package that is empty from the peg and inserting a new yarn supply package into the peg. In the drawing and false twisting machine, yarn is unwound from the yarn supply package inserted into the peg, and a false twisting process is performed on the yarn by a false twisting device.

PRIOR-ART DOCUMENTS

PATENT DOCUMENTS

[0004] PTL 1: Japanese Unexamined Patent Publication No. H5(1993)-32377

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] The yarn unwound from the yarn supply package forms a balloon just downstream of the yarn supply package due to the rotation and centrifugal force. The position where the balloon is formed is between the yarn supply package and a yarn guide located immediately downstream of the yarn supply package.

[0006] As the yarn feed progresses and the diameter of the yarn supply package gradually decreases, the shape of the balloon changes accordingly. If the shape of the balloon is not stable, yarn unwinding from the yarn supply package may not be smooth.

[0007] The present invention is made in view of the above circumstances, and its purpose is to ensure the smoothness of yarn unwinding from the yarn supply package even if the unwinding of the yarn from the yarn supply package progresses.

MEANS FOR SOLVING THE PROBLEMS AND EFFECTS THEREOF

[0008] The problem to be solved is as described above, and the means to solve this problem and its effect are

described below.

[0009] According to the first aspect of the present invention, a work robot with the following configuration is provided. That is, this work robot is a work robot that performs work for a yarn processing machine. The yarn processing machine includes a yarn supply holder, a processing position, and a yarn guide. A yarn supply package wound with yarn made of a synthetic fiber can be set on the yarn supply holder. In the processing position, the yarn from the yarn supply package set on the yarn supply holder is processed to form a wind package. The yarn guide guides the yarn at a downstream end of a balloon formed by the yarn unwound from the yarn supply package set on the yarn supply holder toward the processing position. The work robot includes a balloon adjustment device that decreases a distance between the yarn supply package from which the yarn is being unwound and the yarn guide, by moving at least one of the yarn supply package from which the yarn is being unwound and the yarn guide as unwinding of the yarn from the yarn supply package progresses.

[0010] This allows the shape of the balloon formed when the yarn is being unwound from the yarn supply package to be controlled so that the unwinding of the yarn can be performed smoothly.

[0011] In the work robot, it is preferred that the balloon adjustment device decreases the distance between the yarn supply package from which the yarn is being unwound and the yarn guide as the unwinding of the yarn from the yarn supply package progresses, under control of a controller.

[0012] As a result, the controller can control the shape of the balloon by controlling the balloon adjustment device.

[0013] It is preferred that the work robot is configured as follows. That is, in the yarn processing machine, a plurality of the processing positions may be provided, and a plurality of the yarn supply holders and a plurality of the yarn guides may be provided corresponding to the plurality of the processing positions respectively. The work robot may include a traveling device and/or an elevation device that enables the balloon adjustment device to travel to positions of the plurality of the yarn supply holders.

[0014] This allows the work robot to work for the plurality of the yarn supply holders using the balloon adjustment device, thereby reducing cost by the common configuration.

[0015] It is preferred that the work robot is configured as follows. That is, the work robot may include a package feeding device that performs work of setting the yarn supply package for each of the plurality of the yarn supply holders. The traveling device and/or the elevation device may enable the package feeding device, together with the balloon adjustment device, to travel to the positions of the plurality of the yarn supply holders.

[0016] This allows the work robot that feeds the yarn supply package to the yarn processing machine to also

perform the balloon adjustment work, thereby reducing costs by the common configuration.

[0017] According to the second aspect of the present invention, a yarn processing system having the following configuration is provided. That is, this yarn processing system includes a yarn processing machine and a work robot that performs work for the yarn processing machine. The yarn processing machine includes a yarn supply holder, a processing position, and a yarn guide. A yarn supply package wound with yarn made of a synthetic fiber can be set on the yarn supply holder. In the processing position, the yarn from the yarn supply package set on the yarn supply holder is processed to form a wind package. The yarn guide guides the yarn at a downstream end of a balloon formed by the yarn unwound from the yarn supply package set on the yarn supply holder toward the processing position. The work robot includes a balloon adjustment device. The balloon adjustment device decreases a distance between the yarn supply package from which the yarn is being unwound and the yarn guide, by moving at least one of the yarn supply package from which the yarn is being unwound and the yarn guide as unwinding of the yarn from the yarn supply package progresses.

[0018] This allows the shape of the balloon formed when the yarn is being unwound from the yarn supply package to be controlled so that the unwinding of the yarn can be performed smoothly.

[0019] It is preferred that the yarn processing system is configured as follows. That is, the yarn processing system may include a controller. The controller may control the balloon adjustment device to decrease the distance between the yarn supply package from which the yarn is being unwound and the yarn guide as the unwinding of the yarn from the yarn supply package progresses.

[0020] This allows the controller to control the balloon shape by controlling the balloon adjustment device.

[0021] It is preferred that the yarn processing system is configured as follows. That is, in the yarn processing machine, a plurality of the processing positions may be provided, and a plurality of the yarn supply holders and a plurality of the yarn guides may be provided corresponding to the plurality of the processing positions respectively. The work robot may include a traveling device and/or an elevation device that enables the balloon adjustment device to travel to positions of the plurality of the yarn supply holders.

[0022] This allows work to be performed on the plurality of yarn supply holders using the balloon adjustment device, thereby reducing cost by the common configuration.

[0023] It is preferred that the yarn processing system is configured as follows. That is, the work robot may include a package feeding device that performs work of setting the yarn supply package for each of the plurality of the yarn supply holders. The traveling device and/or the elevation device may enable the package feeding device, together with the balloon adjustment device, to travel to the positions of the plurality of the yarn supply

holders.

[0024] This allows the work robot that feeds the yarn supply package to the yarn processing machine to also perform the balloon adjustment work, thereby reducing costs by the common configuration.

[0025] It is preferred that the yarn processing system is configured as follows. That is, the balloon adjustment device of the work robot may perform decreasing in steps the distance between the yarn supply package from which the yarn is being unwound and the yarn guide, by moving in steps at least one of the yarn supply package from which the yarn is being unwound and the yarn guide as the unwinding of the yarn from the yarn supply package progresses.

[0026] This allows the distance adjustment between the yarn supply package from which the yarn is being unwound and the yarn guide to be performed at intervals of time. Thus, the work robot can perform other work between the distance adjustment work, which can be efficiently utilized.

[0027] According to the third aspect of the present invention, a yarn processing system having the following configuration is provided. That is, the yarn processing system includes a yarn processing machine and a work robot. The work robot performs work for the yarn processing machine. The yarn processing machine includes a yarn supply holder, a processing position, and a yarn guide. A yarn supply package wound with yarn made of a synthetic fiber can be set on the yarn supply holder. In the processing position, the yarn from the yarn supply package set on the yarn supply holder is processed to form a wind package. The yarn guide guides the yarn at a downstream end of a balloon formed by the yarn unwound from the yarn supply package set on the yarn supply holder toward the processing position. One pair of the yarn supply holders is provided for the processing position and one yarn guide that is commonly used for the pair of the yarn supply holders is provided. The yarn processing machine includes a during-unwinding yarn supply package detection device. The during-unwinding yarn supply package detection device detects which of two yarn supply packages set on the two yarn supply holders the yarn is being unwound from. The work robot includes a balloon adjustment device. The balloon adjustment device decreases a distance between the yarn supply package from which the yarn is being unwound and the yarn guide, by moving at least one of the yarn supply package from which the yarn is being unwound and the yarn guide as unwinding of the yarn from the yarn supply package where the yarn is detected as being unwound by the during-unwinding yarn supply package detection device progresses.

[0028] This allows the shape of the balloon formed when the yarn is being unwound from the yarn supply package to be controlled so that the unwinding of the yarn can be performed smoothly. By switching between the yarn supply package from which the yarn is being unwound and the yarn supply package on the standby

side as appropriate, the continuity of yarn supply to the yarn processing machine can be ensured. By detecting the yarn supply package from which the yarn is being unwound of the two yarn supply packages, the shape of the balloon formed in this yarn supply package can be properly controlled.

[0029] It is preferred that the yarn processing system is configured as follows. That is, the yarn processing system may include a controller. The controller may control the balloon adjustment device to decrease the distance between the yarn supply package from which the yarn is being unwound and the yarn guide as the unwinding of the yarn from the yarn supply package progresses, based on a detection result of the during-unwinding yarn supply package detection device.

[0030] As a result, the controller can control the shape of the balloon by controlling the balloon adjustment device.

[0031] It is preferred that the yarn processing system is configured as follows. That is, in the yarn processing machine, a plurality of the processing positions may be provided, and a plurality of the yarn supply holders and a plurality of the yarn guides may be provided corresponding to the plurality of the processing positions respectively. The work robot may include a traveling device and/or an elevation device that enables the balloon adjustment device to travel to positions of the plurality of the yarn supply holders.

[0032] This allows the work robot to work for the plurality of yarn supply holders using the balloon adjustment device, thereby reducing cost by the common configuration.

[0033] It is preferred that the yarn processing system is configured as follows. That is, the work robot may have a package feeding device. The package feeding device may perform work of setting the yarn supply package for each of the plurality of the yarn supply holders. The traveling device and/or the elevation device may enable the package feeding device, together with the balloon adjustment device, to travel to the positions of the plurality of the yarn supply holders.

[0034] This allows the work robot that feeds the yarn supply package to the yarn processing machine to also perform the balloon adjustment work, thereby reducing costs by the common configuration.

[0035] It is preferred that the yarn processing system is configured as follows. That is, the balloon adjustment device of the work robot may perform decreasing in steps the distance between the yarn supply package from which the yarn is being unwound and the yarn guide, by moving in steps at least one of the yarn supply package from which the yarn is being unwound and the yarn guide as the unwinding of the yarn from the yarn supply package progresses.

[0036] This allows the distance adjustment between the yarn supply package from which the yarn is being unwound and the yarn guide to be performed at intervals of time. Thus, the work robot can perform other work

between the distance adjustment work, which can be efficiently utilized.

[0037] In the yarn processing system described above, it is preferred that in the yarn supply holder, at least a portion on which the yarn supply package is set may be capable of approaching and separating with respect to the yarn guide.

[0038] This allows the yarn supply package to move smoothly. Thus, the distance adjustment between the yarn supply package from which the yarn is being unwound and the yarn guide can be easily adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039]

FIG. 1 is a side view showing an overall configuration of a false twisting system according to one embodiment of this invention.

FIG. 2 is a side view showing a situation where a yarn supply cart picks a yarn supply package out from a stocker.

FIG. 3 is a side view showing a situation where the yarn supply cart removes an empty bobbin from a peg.

FIG. 4 is a side view showing a situation where the yarn supply cart hangs a yarn supply package on a peg.

FIG. 5 is a side view showing a situation where the yarn supply cart has been completed setting the yarn supply package onto the peg.

FIG. 6 is a side view showing a situation where the yarn supply cart pushes the yarn supply package closer to the yarn guide when the diameter of the yarn supply package is reduced.

FIG. 7 is a diagonal view showing a configuration of a pushing device.

FIG. 8 is a schematic view showing a drawing and false twisting machine developed along a yarn path.

FIG. 9 is a schematic view showing a modification of a configuration for detecting which of two yarn supply packages the yarn is being unwound from.

FIG. 10 is an enlarged diagonal view showing a situation where the yarn supply package is pushed by the pushing device in detail.

FIG. 11 is a diagonal view showing a modification of a configuration for moving the yarn supply package.

EMBODIMENT FOR CARRYING OUT THE INVENTION

[0040] Next, embodiments of this invention will be described with reference to the drawings. FIG. 1 is a side view showing an overall configuration of a false twisting system 100 according to one embodiment of this invention.

[0041] The false twisting system (an example of a "yarn processing system") 100 shown in FIG. 1 includes a drawing and false twisting machine 1, a yarn supply cart

(an example of a "work robot") 50, a carry-out cart 90, and a controller 40. The drawing and false twisting machine 1 is a type of yarn processing machine. Other yarn processing machines include, for example, air processing machines. The drawing and false twisting machine 1 can produce stretched and false twisted yarn called DTY by stretching and false twisting a semi-stretched yarn (partially oriented yarn) called POY, which is a type of yarn (a type of synthetic fiber yarn). POY is an abbreviation for Partially Oriented Yarn. DTY is an abbreviation for Draw Textured Yarn.

[0042] The drawing and false twisting machine 1 includes a creel 11 and a main unit 31. The main unit 31 includes a plurality of processing positions (also called "spindles") 35. Each processing position 35 has a first feed roller 21, a second feed roller 22, a third feed roller 23, a false twisting device 25, a first heater 26, a second heater 27, and a winder 28. In the drawing and false twisting machine 1, a plurality of processing positions 35 constituting the main unit 31 are arranged in parallel, except at the winder 28. The winder 28 is arranged in a 3-rows x m-columns (m is a predetermined integer) arrangement of a plurality of winders 28 according to the plurality of processing positions 35.

[0043] The creel 11 includes a plurality of pegs (yarn supply holders) 12. When viewed from the yarn supply cart 50 side, the pegs 12 are arranged in a matrix of 4 rows x n columns (n is a predetermined integer). On each of the pegs 12, a yarn supply package 5 can be set. The yarn supply package 5 is made of the POY wound around a core tube. The yarn supply package 5 is formed when the POY is made in a spinning machine of a spinning winder, not shown, and the POY is wound onto the core tube in the winder of the spinning winder. The numerous pegs 12 of the creel 11 are divided so that there are two pegs 12 per the processing position 35.

[0044] FIG. 7 shows two pegs corresponding to one processing position 35. As shown in FIG. 7, the pegs 12 are provided in pairs. Two pegs belonging to the same pair are arranged adjacent to each other in a horizontal direction. The two pegs belonging to the same pair are provided for one processing position 35. While yarn 3 is being unwound from the yarn supply package 5 attached to one peg 12 toward one processing position 35, the yarn supply package 5 attached to the other peg 12 is on standby. The yarn trailing end of the yarn supply package 5 on the side from which the yarn 3 is being unwound is coupled to the yarn leading end of the yarn supply package 5 on the standby side. Therefore, when all the yarn 3 is unwound from one of the two yarn supply packages 5, from the remaining yarn supply package 5 the yarn is automatically unwound. Of the two yarn supply packages 5 of the same set, the yarn supply package 5 on the side where the yarn is being unwound is referred to as during-unwinding yarn supply package 5, and the yarn supply package 5 on the remaining side is called the standby yarn supply package 5.

[0045] The yarn supply cart 50 is configured so that it

can travel to the position of each peg 12 of the creel 11 to remove the yarn supply package 5, in which all the yarn has been unwound and is in the core tube state (this state is called "empty bobbin") from the peg 12, and set a new bobbin on the peg 12. The empty bobbin is carried out of the drawing and false twisting machine 1 by the yarn supply cart 50, and the new yarn supply package 5 is brought in from outside the drawing and false twisting machine 1 by the yarn supply cart 50.

[0046] A yarn guide 13 is provided downstream of the two pegs 12 in a yarn traveling direction. The yarn guide 13 is located one for each of the two pegs 12 belonging to the same pair. The two pegs 12 are arranged so that the tips of the pegs 12 face the yarn guide 13. Thus, the two pegs 12 are not oriented so that they are parallel. No matter which the yarn 3 is unwound from the two yarn supply packages 5, the yarn 3 passes through the common yarn guide 13.

[0047] The yarn guide 13 is the guiding member through which the yarn 3 is unwound from the yarn supply package 5 passes first. Thus, the yarn 3 forms a balloon between the yarn supply package 5 and the yarn guide 13. The yarn guide 13 is located at the downstream end of the balloon.

[0048] Hereinafter, the configuration for yarn feeding comprising one yarn guide 13 and a pair of pegs 12 may be referred to as a yarn supplying position 9. One yarn supplying position 9 corresponds to one processing position 35. A number of yarn supplying positions 9 equal to the number of processing positions 35 are located on the creel 11.

[0049] As shown in FIG. 8, the yarn guide 13 includes a yarn unwinding detection sensor (an example of a "during-unwinding yarn supply package detection device") 16. The yarn unwinding detection sensor 16 can detect which of the two yarn supply packages 5 respectively attached to the two pegs 12 belonging to the same set, the yarn is being unwound from. The yarn unwinding detection sensor 16 is electrically connected to the controller 40 described above. In FIG. 8, the pair of pegs 12 are depicted so that they are parallel for the sake of drawing simplicity. The same is true in FIG. 9 described later.

[0050] The yarn unwinding detection sensor 16 includes a first detector 17 and a second detector 18. The first detector 17 is configured to detect whether or not the yarn 3 is being unwound from one of the two yarn supply packages 5 attached to the two pegs 12 belonging to the same pair. The second detector 18 is configured to detect whether or not the yarn 3 is being unwound from the other of the two yarn supply packages 5 described above. Each of the first detector 17 and the second detector 18 is, for example, an optical sensor that optically detects the yarn 3. For more details of the yarn unwinding detection sensor 16, for example, see Japanese Patent No. 5873105. Each of the first detector 17 and the second detector 18 may be, for example, a contact-type sensor instead of the optical sensor. Based on the detection result of the sensor 16, the controller 40 can detect that the

unwinding source of the yarn has switched from one of the two yarn supply packages 5 to the other, thereby detecting that one is empty. The details of the control performed by the controller 40 will be described later.

[0051] In addition to the above, the following method can be used to detect which of the two yarn supply packages 5 respectively attached to the two pegs 12 belonging to the same pair, the yarn is being unwound from.

[0052] FIG. 9 shows a modification including a joint detection sensor 19 that detects the joint K between the yarn trailing end of one of the two yarn supply packages 5 of the same set and the yarn leading end of the other. The joint detection sensor 19 is electrically connected to the controller 40 described above. By the joint detection sensor 19 detecting the presence of the joint K, it is possible to detect which of the yarn supply packages 5 the yarn is being unwound from. Specifically, when the unwinding source of the yarn 3 is switched from one yarn supply package 5 to the other yarn supply package 5, the joint K leaves from the sensor 19. Based on the joint detection sensor 19, the controller 40 can determine whether or not the yarn supply package 5 in which the yarn is being unwound has been switched.

[0053] By checking the change in diameter of each of the two yarn supply packages 5 belonging to the same set with a sensor that directly measures the diameter of each of them, it is also possible to detect which of the two yarn supply packages 5 the yarn is being unwound from. The detection is also possible by capturing the same set of two yarn supply packages 5 with a camera and analyzing the image.

[0054] Corresponding to each of the pegs 12, a peg shaft 14 in a vertically elongated shape is provided on the creel 11. Each peg shaft 14 is supported in the creel 11 in a rotatable manner about a vertical axis. As shown in FIG. 1, at a position above the peg 12, a rotation input member 15 is provided to the peg shaft 14. The rotation input member 15 including rod-shaped members arranged radially. When the rotation input member 15 rotates, the peg 12 swivels via the peg shaft 14. This allows the peg 12 to switch between a position where its tip faces the yarn guide 13 and a position where its tip faces the yarn supply cart 50 side.

[0055] As shown in FIG. 1, the yarn 3 fed downstream from the yarn guide 13 passes through the first feed roller 21. Between the first feed roller 21 and the second feed roller 22, an appropriate tension is applied to the yarn 3 for stretching. The false twisting device 25 is located downstream between the first feed roller 21 and the second feed roller 22. The false twisting device 25 applies a twist to the yarn 3 so that the yarn 3 between the first feed roller 21 and the false twisting device 25 becomes twisted.

[0056] Between the first feed roller 21 and the false twisting device 25, the first heater 26 is provided for thermal fixing. The yarn 3 is heated by the first heater 26 to a temperature at which it can be stretched.

[0057] The yarn 3 sent downstream from the false

twisting device 25 passes through the second feed roller 22. Between the second feed roller 22 and the third feed roller 23, the yarn 3 is relaxed.

[0058] Between the second feed roller 22 and the third feed roller 23, the second heater 27 is provided for thermal fixing. The yarn 3 is heated again by the second heater 27 while being relaxed.

[0059] The yarn 3 passing through the third feed roller 23 is sent to the winder 28. The winder 28 winds the fed yarn 3 onto a core tube to form a DTY package (called a "wind package") 6. When fully wound, the wind package 6 is removed from the winder 28 by a doffing device, not shown, and moved to the carry-out cart 90. The wind package 6 is carried out of the drawing and false twisting machine 1 by the carry-out cart 90. The carry-out cart 90 can be configured as an overhead cart, for example.

[0060] Next, the yarn supply cart 50 will be described. The yarn supply cart 50 corresponds to an outside work robot in relation to the drawing and false twisting machine 1. The yarn supply cart 50 performs the setting work of the yarn supply package 5, etc., to the creel 11 of the drawing and false twisting machine 1 from the outside.

[0061] The yarn supply cart 50 includes a traveling member 51 (part of a "traveling device"), an elevation member 52 (part of a "elevation device"), a peg swivel device 53, a swivel head 54, a yarn supply package setting device 55 (part of a "package feeding device"), an empty bobbin retrieval device 56, and a yarn supply package position adjustment device 57 (an example of the "balloon adjustment device").

[0062] The traveling member 51 includes a base member 61 and a pillar member 62.

[0063] The base member 61 is movable along the longitudinal direction of a rail 63 installed on the ground. The longitudinal direction of the rail 63 is oriented parallel to the direction in which a set of pegs 12 are horizontally lined up in the creel 11.

[0064] The pillar member 62 is an elongated member extending in a vertical direction. The pillar member 62 is arranged to project upward from the base member 61.

[0065] The elevation member 52 can be raised and lowered along the longitudinal direction of the pillar member 62. The peg swivel device 53, and the swivel head 54 will be described later, are arranged on the elevation member 52.

[0066] The yarn supply cart 50 has a plurality of actuators not shown. This allows the traveling member 51 to travel horizontally along the rail 63 and the elevation member 52 to travel vertically.

[0067] The peg swivel device 53 is attached to the top of the elevation member 52. The peg swivel device 53 includes an engaging head 64 that can rotate in engagement with the rotation input member 15.

[0068] The engaging head 64 includes a rotating disk. A plurality of pins elongated in the vertical direction are provided on the bottom surface of the rotating disk. The pins are lined up at equal intervals in the circumferential direction of the rotating disk. To rotate the rotating disk,

an actuator not shown is provided in the peg swivel device 53. When the rotating disk is rotated while the pin is between the rod-shaped members of the rotation input member 15, the rotation input member 15 can be rotated. As a result, the peg shaft 14 can be rotated to change the orientation of the peg 12.

[0069] The peg swivel device 53 includes an actuator, not shown. The actuator can move the engaging head 64 in a direction closer to and away from the peg shaft 14 of the creel 11. Thus, the engaging head 64 can be engaged with the rotation input member 15 only when necessary.

[0070] A pivot shaft 65 is provided protruding from the bottom surface of the peg swivel device 53. The swivel head 54 is arranged to be suspended from the peg swivel device 53 via the pivot shaft 65.

[0071] The yarn supply cart 50 includes an actuator, not shown. The actuator allows the swivel head 54 to swivel about the pivot shaft 65.

[0072] The yarn supply package setting device 55, the empty bobbin retrieval device 56, and a yarn supply package position adjustment device 57 are attached to the swivel head 54.

[0073] The yarn supply package setting device 55 includes a delivery peg 68 that can slide. The delivery peg 68 can hang and hold the yarn supply package 5 to be set on the peg 12 of the creel 11. To move the delivery peg 68 in the longitudinal direction, an actuator not shown is provided in the yarn supply package setting device 55.

[0074] A stocker 66 is provided adjacent to the travel path of the yarn supply cart 50. The stocker 66 can store a plurality of yarn supply packages 5. The stocker 66 is provided on the opposite side of the creel 11 across the travel path of the yarn supply cart 50. However, the stocker 66 may be provided on the same side as the creel 11.

[0075] As the swivel head 54 swivels, the orientation of the yarn supply package setting device 55 can be changed between a state where the delivery peg 68 faces the stocker 66 and a state where the delivery peg 68 faces the creel 11.

[0076] The empty bobbin retrieval device 56 includes a retraction member 69 that can slide. The retraction member 69 is linearly elongated. In a plan view, the longitudinal direction of the retraction member 69 is 90° different from the longitudinal direction of the delivery peg 68. At the end of the retraction member 69, a hooking portion is formed that is bent to face upward.

[0077] The controller 40 is configured as a known computer equipped with a processor, a memory unit, and the like. The controller 40 manages and/or controls the drawing and false twisting machine 1, the yarn supply cart 50, and the carry-out cart 90. The controller 40 may be provided respectively for the drawing and false twisting machine 1, the yarn supply cart 50, and the carry-out cart 90. The controller 40 receives a signal from the yarn unwinding detection sensor provided in each of the yarn supplying positions 9 of the drawing and false twisting machine 1. This allows the controller 40 to detect which

of the yarn supply packages 5 attached to the two pegs 12 of the same set in each yarn supplying position 9 is the during-unwinding yarn supply package, and to detect that the unwinding source of the yarn has switched from one of the two yarn supply packages 5 to the other. The controller 40 can also detect that one of the yarn supply packages 5 is empty (running out of the yarn) by detecting that the unwinding source of the yarn has switched from one to the other. Furthermore, by detecting that the unwinding source of the yarn has been switched, the diameter and the total yarn length of the initial yarn supply package 5 that is fully wound, the unwinding speed of the yarn, and the elapsed time since the unwinding source of the yarn supply package 5 was switched, the controller 40 can acquire the diameter of the during-unwinding yarn supply package 5. In other words, the controller 40 includes a yarn-unwinding yarn supply package diameter detection means which determines the diameter of the during-unwinding yarn supply package 5. In this example, the yarn-unwinding yarn supply package diameter detection means is designed to detect the diameter of the during-unwinding yarn supply package 5 in three steps, that is, a large diameter, a medium diameter, and a small diameter, from the fully-wound yarn supply package 5 until it becomes empty. The respective values for the large diameter, the medium diameter, and the small diameter are set appropriately. The detection of the controller 40 as described above is possible at all yarn supplying positions 9 (in other words, all processing positions 35).

[0078] The yarn supply cart 50 operates according to a command from the controller 40. The yarn supply package position adjustment device 57 provided on the yarn supply cart 50 operates, similarly to the yarn supply cart 50, according to a command from the controller 40. When the yarn supply package 5 is empty during the unwinding of the yarn in a certain yarn supplying position 9, the controller 40 commands the yarn supply cart 50 to travel to this yarn supplying position 9. In addition, when the diameter of the yarn supply package 5 change from a large diameter to a medium diameter or from a medium diameter to a small diameter during the unwinding of the yarn in a certain yarn supplying position 9, the controller 40 commands the yarn supply cart 50 to travel to this yarn supplying position 9. It can happen that the during-unwinding yarn supply package 5 becomes empty, that the diameter of the during-unwinding yarn supply package 5 changes from the large diameter to the medium diameter, or from the medium diameter to the small diameter, in multiple yarn supplying positions 9 at about the same time, and in cases like this, the yarn supply cart 50 travels to the yarn supplying position 9 with a higher priority in accordance with the predetermined priority order.

[0079] The yarn supply cart 50 which travels to the yarn supplying position 9 where the diameter of the yarn supply package 5 is changed from the large diameter to the medium diameter, or from the medium diameter to the

small diameter, moves the during-unwinding yarn supply package 5 closer to the yarn guide 13 at this yarn supplying position 9 by the yarn supply package position adjustment device 57.

[0080] Next, the operation of the yarn supply cart 50 when all the yarn 3 is unwound from the yarn supply package 5 hang on the peg 12 on the creel 11 will be described.

[0081] As shown in FIG. 2, when all of the yarn 3 has been unwound from the yarn supply package 5 at a certain yarn supplying position 9 and it becomes an empty bobbin 5a, the yarn supply cart 50 first travels to the stocker 66 and stops. As described above, the controller 40 can detect that all the yarn 3 from the yarn supply package 5 has been unwound at a certain yarn supplying position 9, resulting in the empty bobbin 5a. In this state, the yarn supply cart 50 rotates the swivel head 54. This allows the delivery peg 68 of the yarn supply package setting device 55 to face the stocker 66. In this state, the delivery peg 68 moves closer to the fully-wound yarn supply package 5 held in the stocker 66 and picks out this yarn supply package 5 from the stocker 66. This allows the yarn supply package 5 stored in the stocker 66 to be hung on the delivery peg 68. With the yarn supply package 5 hung, the delivery peg 68 moves away from the stocker 66.

[0082] Next, upon receiving a command from the controller 40, the yarn supply cart 50 travels along the rail 63 and moves the elevation member 52 in the vertical direction as necessary. The yarn supply cart 50 comes to rest in a state where the elevation member 52 is positioned near the peg 12 of the yarn supplying position 9 where the empty bobbin has appeared.

[0083] At about the same time as the elevation member 52 moves, the yarn supply cart 50 turns the swivel head 54 and changes the orientation of the empty bobbin retrieval device 56 so that the retraction member 69 is facing the creel 11. The empty bobbin retrieval device 56 then moves the retraction member 69 closer to the creel 11. As a result, the hooking portion of the retraction member 69 is in close proximity to the root area of the peg 12. In this state, the peg swivel device 53 engages the engaging head 64 to the rotation input member 15 and rotates it, so that the peg 12 with the empty bobbin 5a hanging on it can be swiveled to face the yarn supply cart 50 side, as shown in FIG. 3. Accordingly, the empty bobbin 5a held by the peg 12 is positioned closer to the yarn supply cart 50 than the hooking portion of the retraction member 69.

[0084] The empty bobbin retrieval device 56 then moves the retraction member 69 away from the creel 11. As a result, the hooking portion of the retraction member 69 pushes the empty bobbin 5a, allowing the empty bobbin 5a to be pulled off the peg 12. The empty bobbin 5a, which is picked out from the peg 12 by the retraction, falls into a receiving tray 67 attached to the swivel head 54.

[0085] After the operation of the empty bobbin retrieval device 56 is completed, the yarn supply cart 50 rotates the swivel head 54. As a result, the yarn supply package

setting device 55 can be oriented so that the delivery peg 68 faces the creel 11. The yarn supply package setting device 55 moves the delivery peg 68, on which the fully-wound yarn supply package 5 is hung, toward the creel 11, as shown in FIG. 4. As a result, the yarn supply package 5 can be hung on the peg 12. The yarn supply package setting device 55 then moves the delivery peg 68 away from the creel 11. Consequently, the yarn supply package 5 is picked out from the delivery peg 68.

[0086] In this state, the peg swivel device 53 rotates the engaging head 64 to engage the rotation input member 15. This allows the peg 12 with the yarn supply package 5 hanging on it to swivel so that it faces the yarn guide 13 side, as shown in FIG. 5.

[0087] By the above, the work of replacing the empty bobbin 5a with a fully-wound yarn supply package 5 is completed. The yarn supply cart 50, after retracting the engaging head 64 of the peg swivel device 53, then travels to transport the empty bobbin 5a collected in the receiving tray 67 to another location. The yarn leading end of the fully-wound yarn supply package 5 set this time on the peg 12 is coupled in an appropriate manner with the yarn trailing end of the yarn supply package 5 on the side where the yarn 3 is being unwound.

[0088] Next, the yarn supply package position adjustment device 57 provided by the yarn supply cart 50 will be described in detail.

[0089] The yarn supply package position adjustment device 57 includes a pushing device 70 that can slide and move, as shown in FIG. 6. The pushing device 70 can push the yarn supply package 5 hanging on the peg 12 from outside the creel 11, thereby bringing the yarn supply package 5 closer to the yarn guide 13 along the longitudinal direction of the peg 12.

[0090] The pushing device 70 includes a slide base 71, a guide plate 72, a motor 73, a pushing member 74, and a rack and pinion mechanism 75, as shown in FIG. 7.

[0091] The slide base 71 is an elongated plate-shaped member. The slide base 71 is located to protrude from the swivel head 54. The direction in which the slide base 71 faces is parallel to the direction in which the delivery peg 68 faces in the yarn supply package setting device 55.

[0092] The swivel head 54 is provided with a rail 81. The slide base 71 can slide along the rail 81. The longitudinal direction of the rail 81 is parallel to the longitudinal direction of the slide base 71.

[0093] To move the slide base 71, a cylinder 82 as an actuator is attached to the swivel head 54. By supplying a working fluid to drive the cylinder 82, the slide base 71 can be moved between a position where its tip is close to the peg shaft 14 and a position where it is retracted from the peg shaft 14. The actuator is not limited to a cylinder, for example, an electric motor can be used.

[0094] The guide plate 72 is fixed to the end of the slide base 71. The guide plate 72 moves integrally with the slide base 71. A rail 83 is fixed to the guide plate 72 that guides the direction of movement of the pushing member

74.

[0095] The motor 73 can drive the pushing member 74. The housing of the motor 73 is fixed to the guide plate 72. A pinion is fixed to the output shaft of the motor 73.

[0096] The pushing member 74 is an L-shaped member. The pushing member 74 can slide along the longitudinal direction of the rail 83. The direction of movement of the pushing member 74 is inclined to the direction of movement of the slide base 71 in a plan view. The direction of movement of the pushing member 74 is substantially parallel to the longitudinal direction of the peg 12. The direction of movement of the pushing member 74 can be said as a direction approaching the yarn guide 13.

[0097] A rack with teeth arranged in a straight line parallel to the rail 83 is formed at a base portion of the pushing member 74. This rack, together with the pinion fixed to the output shaft of the motor 73, constitutes the rack and pinion mechanism 75.

[0098] The tip of the pushing member 74 is bent in an L-shape. This bent portion can contact one of the end faces that the core tube of the yarn supply package 5 hung on the peg 12 has, which is far from the yarn guide 13. The position where the pushing member 74 contacts the core tube is lower than the peg 12.

[0099] As described above, the controller 40 estimates and measures the cumulative length of the yarn 3 that has been unwound since the new yarn supply package 5 was set, based on the diameter and the total yarn length of the new yarn supply package 5, the unwinding speed of the yarn, or the like, and estimates the diameter of the during-unwinding yarn supply package 5 based on this cumulative length. It is also possible that the diameter of the yarn supply package 5 being unwound is measured by an appropriate sensor, and the measurement result is sent to the controller 40. When the estimated diameter of the yarn supply package 5 becomes less than a predetermined value, the controller 40 sends a position adjustment request signal to the yarn supply cart 50.

[0100] Upon receiving the position adjustment request signal, the yarn supply cart 50 operates the pushing device 70 of the yarn supply package position adjustment device 57 at the position corresponding to the yarn supply package 5 that is being unwound, in the yarn supplying position 9 identified based on the signal. Specifically, the pushing device 70 drives the cylinder 82 to advance the slide base 71 toward the creel 11. As a result, the pushing member 74 positioned at the tip of the slide base 71 comes into close proximity to the base of the peg 12. Next, the pushing device 70 drives the motor 73 to move the pushing member 74 the required distance by the rack and pinion mechanism 75. This allows the tip of the pushing member 74 to push the core tube so that the yarn supply package 5 can be moved along the longitudinal direction of the peg 12 while sliding relative to the peg 12. As a result, the distance between the yarn guide 13 and the yarn supply package 5 is decreased, so that the balloon between the yarn guide 13 and the yarn supply package 5 is formed in a stable manner.

[0101] When the movement of the yarn supply package 5 is completed, the pushing device 70 drives the motor 73 in the opposite direction to that described above. As a result, the pushing member 74 moves away from the yarn supply package 5. After the pushing member 74 returns to its original position, the pushing device 70 drives the cylinder 82 to retract the slide base 71 against the creel 11.

[0102] Generally, a large number of yarn supply packages 5 are set on the creel 11 of the drawing and false twisting machine 1, and many pieces of the yarn 3 are unwound simultaneously and in parallel. In this embodiment, one yarn supply cart 50 adjusts the positions of this large number of the yarn supply packages 5. When the number of target yarn supply packages 5 is large, it is difficult to move each of the yarn supply packages 5 in a fine manner. However, if the yarn supply packages 5 can be moved even in rough steps, the unwinding of the yarn 3 from the yarn supply packages 5 will be smoother and the tension of the unwound yarn 3 will be more stable.

[0103] Although not shown in the figure, the yarn supply package position adjustment device 57 includes a reversing device that changes the orientation of the pushing device 70. The reversing device can rotate the pushing device 70 180° around an axis parallel to the longitudinal direction of the slide base 71. As shown in FIG. 10, the two pegs 12 belonging to the same pair have different orientations from each other. In FIG. 10, the pushing device 70 which is inverted is depicted by chain lines. The reversing device reverses the orientation of the pushing device 70 as needed to move the yarn supply package 5 along the peg 12 and achieve balloon control, no matter which of the two yarn supply packages 5 the yarn 3 is unwound from.

[0104] As explained above, the yarn supply cart 50 in this embodiment is a work robot, outside the machine, that performs the work for the drawing and false twisting machine 1. The drawing and false twisting machine 1 includes the peg 12, the processing position 35, and the yarn guide 13. The yarn supply package 5 wound with the yarn 3 that is the POY can be set on the peg 12. In the processing position 35, the yarn 3 from the yarn supply package 5 set on the peg 12 is processed to form the wind package 6. The yarn guide 13 guides the yarn 3 at the downstream end of the balloon formed by the yarn 3 unwound from the yarn supply package 5 set on the peg 12. The yarn supply cart 50 includes a yarn supply package position adjustment device 57. The yarn supply package position adjustment device 57 decreases the distance between the yarn supply package 5 and the yarn guide 13, by moving at least any of the yarn supply package 5 from which the yarn is being unwound and the yarn guide 13 as the unwinding of the yarn 3 from the yarn supply package 5 progresses.

[0105] This allows the shape of the balloon formed when the yarn 3 is being unwound from the yarn supply package 5 to be controlled so that the unwinding of the

yarn 3 can be performed smoothly. Since the yarn supply cart 50, which is the robot outside the machine, performs the work for controlling the balloon, there is no need to make major changes to the configuration of the drawing and false twisting machine 1. Therefore, it is easy to apply the system to the existing drawing and false twisting machine 1.

[0106] The false twisting system 100 of this embodiment includes the controller 40. In the yarn supply cart 50, the yarn supply package position adjustment device 57 decreases the distance between the yarn supply package 5 from which the yarn is being unwound and the yarn guide 13 as the unwinding of the yarn 3 from the yarn supply package 5 progresses, under the control of the controller 40.

[0107] As a result, the controller 40 can control the shape of the balloon by controlling the yarn supply package position adjustment device 57.

[0108] In the drawing and false twisting machine 1 of this embodiment, the plurality of processing positions 35 are provided, and the plurality of pegs 12 and the plurality of yarn guides 13 are provided corresponding to the plurality of the processing positions 35, respectively. The yarn supply cart 50 includes the traveling member 51 and the elevation member 52 that enable the yarn supply package position adjustment device 57 to travel to the positions of the plurality of the pegs 12.

[0109] This allows the yarn supply cart 50 to work for the plurality of the pegs 12 using the yarn supply package position adjustment device 57, thereby reducing cost by the common configuration.

[0110] A configuration that a robot different from the yarn supply cart 50 performs the balloon adjustment work described above is also possible. This robot corresponds to a robot outside the machine for the drawing and false twisting machine 1 and performs only the balloon adjustment work. The configuration of the robot is arbitrary, but it can be configured as an arm robot that travels itself, for example. The robot can move the yarn supply package 5 by pushing the end face of the yarn supply package 5 with the tip of the arm.

[0111] In this configuration, the control of the robot can be simplified.

[0112] In this embodiment, the yarn supply cart 50 includes the yarn supply package setting device 55. The yarn supply package setting device 55 performs the work of setting the yarn supply package 5 for each of the plurality of pegs 12. The traveling member 51 and the elevation member 52 enable the yarn supply package setting device 55, together with the yarn supply package position adjustment device 57, to travel to the positions of the plurality of pegs 12.

[0113] This allows the yarn supply cart 50 that feeds the yarn supply package 5 to the drawing and false twisting machine 1 to also perform the balloon adjustment work, thereby reducing costs by the common configuration.

[0114] In the drawing and false twisting machine 1 of

this embodiment, one yarn guide 13 is commonly used for two pegs 12. The yarn supply cart 50 is capable of moving the respective yarn supply packages 5 set on the two pegs 12.

[0115] This allows for continuity of yarn supply to the drawing and false twisting machine 1 by switching between the yarn supply package 5 from which the yarn 3 is being unwound and the yarn supply package 5 on the standby side, as appropriate. No matter which of the two yarn supply packages 5 the yarn is unwound from, the shape of the balloon can be controlled to achieve smooth unwinding of the yarn 3.

[0116] In the yarn supply cart 50 of this embodiment, the position of the yarn supply package 5 can be changed with respect to the peg 12 in the longitudinal direction of the peg 12. In the balloon adjustment work, the yarn supply cart 50 applies a force to the yarn supply package 5 to move it with respect to the peg 12.

[0117] This allows the balloon shape to be controlled while holding the yarn supply package 5 with a simple configuration.

[0118] Next, a modification of the above embodiment will be described. FIG. 11 is a diagonal view showing the modification. In the description of this modification, members identical or similar to those of the above-described embodiment are given the same reference signs on the drawing, and descriptions thereof may be omitted.

[0119] In the modification shown in FIG. 11, pegs 12x are configured to be slidable with respect to the peg shaft 14 in the longitudinal direction of the pegs 12x (in other words, in a direction approaching and separating the yarn guide 13). Two pegs 12x are arranged in parallel, appropriately spaced apart, to hang one yarn supply package 5. Each of the peg 12x extends from the portion supporting the yarn supply package 5 to the opposite side across the peg shaft 14. A transmission member 84 is fixed to the end of the peg 12x opposite the portion supporting the yarn supply package 5. The transmission member 84 is formed in a plate shape. The pushing member 74 of the pushing device 70 can contact the transmission member 84.

[0120] In this modification, the pushing member 74 of the pushing device 70 pushes the transmission member 84 instead of directly pushing the yarn supply package 5. As a result, the entire pegs 12x move, including a portion on which the yarn supply package 5 is set. Thus, the yarn supply package 5 can slide together with the pegs 12x in a direction closer to the yarn guide 13. Only a portion of the pegs 12x on which the yarn supply package 5 is set may slide.

[0121] While suitable embodiments and modifications of the invention have been described above, the above configuration can be modified, for example, as follows. The changes may be made independently or in any combination of several changes.

[0122] The creel 11 is not limited to a configuration with one yarn guide 13 for two pegs 12, 12x, but can be configured with one yarn guide 13 for one peg 12. The same

is true in the modification of FIG. 11.

[0123] In the creel 11, the yarn guide 13 may be provided so that its position is changeable. For example, it can be configured so that the yarn supply cart 50 applies a force to the yarn guide 13 so that it moves in a direction closer to the yarn supply package 5. For example, instead of the pushing device 70, a device (an example of a "balloon adjustment device") could be provided that pulls the yarn guide 13 toward the yarn supply cart 50 using a member similar to the retraction member 69. It could be configured to move both the yarn supply package 5 and the yarn guide 13 as the diameter of the yarn supply package 5 decreases. However, in the case of changing the position of the yarn guide 13, it is necessary to return the position of the yarn guide 13 to its initial position (moving the yarn guide 13 away from the yarn supply package 5) when the unwinding source of the yarn has switched from one of the two yarn supply packages 5 to the other.

[0124] Instead of estimating the diameter of the yarn supply package 5 based on the length of the unwound yarn 3, the diameter of the yarn supply package 5 can be actually detected using an appropriate sensor.

[0125] A plurality of yarn supply carts 50 may be provided for the creel 11.

[0126] In the above embodiment and modification, the yarn supply package position adjustment device 57 is provided on the yarn supply cart 50, but the yarn supply package position adjustment device 57 may be configured separately from the yarn supply cart 50. That is, a work robot with the yarn supply package position adjustment device 57 (the "work robot" of the present invention) and a work robot as the yarn supply cart 50 not having the yarn supply package position adjustment device 57 may be provided respectively. In this case, one or both of the respective work robots may be provided in plurality.

[0127] The work robot having the yarn supply package position adjustment device 57, i.e., the work robot having the balloon adjustment device, may be movable as well as the yarn supply cart 50, or may be installed fixedly. In the case of a fixed installation, the work robot can be installed for each yarn supplying position 9 or for every a plurality of the yarn supplying positions 9. In the case of installing correspondingly for each yarn supplying position 9, one work robot may be provided for each set of the pegs 12, or one work robot may be provided for each peg 12 in a set of the pegs 12. In the case of installing correspondingly for each of the multiple yarn supplying positions 9, for example, the balloon adjustment device can be raised and lowered so that it can travel to each of the pegs 12 of the multiple yarn supplying positions 9 arranged in the vertical direction of the creel 11.

[0128] The configuration of the false twisting machine is not limited to the drawing and false twisting machine 1 of FIG. 1, but can be modified in various ways.

DESCRIPTION OF THE REFERENCE NUMERALS

[0129]

1	Drawing and false twisting machine (false twisting machine, yarn processing machine)
3	Yarn
5	Yarn supply package
11	Creel
12, 12x	Peg (yarn supply holder)
13	Yarn guide
50	Yarn supply cart (robot)

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Claims

1. A work robot (50) for a yarn processing machine, wherein the yarn processing machine comprises a yarn supply holder (12) on which a yarn supply package (5) wound with yarn can be set; a processing position (35) where the yarn (3) from the yarn supply package (5) set on the yarn supply holder (12) is processed to form a wind package (6); and a yarn guide (13) for guiding the yarn (3) at a downstream end of a balloon formed by the yarn (3) unwound from the yarn supply package (5) set on the yarn supply holder (12) toward the processing position (35), the work robot including:

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a balloon adjustment device (57) configured to decrease a distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), by moving at least one of the yarn supply package (5) from which the yarn is being unwound and the yarn guide (13), as unwinding of the yarn (3) from the yarn supply package (5) progresses.

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2. The work robot according to claim 1, wherein the balloon adjustment device (57) is configured to decrease the distance between the yarn supply package (5) from which the yarn is being unwound and the yarn guide (13) as the unwinding of the yarn (3) from the yarn supply package (5) progresses, under control of a controller (40).

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3. The work robot according to claim 1 or 2, wherein

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in the yarn processing machine, a plurality of the processing positions (35) is provided, and a plurality of the yarn supply holders (12) and a plurality of the yarn guides (13) are provided corresponding to the plurality of the processing positions (35) respectively, and the work robot (50) includes a traveling device (51) and/or an elevation device (52) configured to enable the balloon adjustment device (57) to travel to positions of the plurality of the yarn supply holders (12).

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4. The work robot according to claim 3, comprising:

a package feeding device for setting the yarn

- supply package (5) for each of the plurality of the yarn supply holders (12),
 wherein the traveling device (51) and/or the elevation device (52) is configured to enable the package feeding device, together with the balloon adjustment device (57), to travel to the positions of the plurality of the yarn supply holders (12).
5. A yarn processing system (100) comprising:
- a yarn processing machine comprising a yarn supply holder (12) on which a yarn supply package (5) wound with yarn can be set, a processing position (35) where the yarn (3) from the yarn supply package (5) set on the yarn supply holder (12) is processed to form a wind package (6), and a yarn guide (13) for guiding the yarn (3) at a downstream end of a balloon formed by the yarn (3) unwound from the yarn supply package (5) set on the yarn supply holder (12) toward the processing position (35); and
 a work robot (50) configured to perform work for the yarn processing machine, the work robot (50) including a balloon adjustment device (57) configured to decrease a distance between the yarn supply package (5) from which the yarn (3) is unwound and the yarn guide (13), by moving at least one of the yarn supply package (5) from which the yarn is being unwound and the yarn guide (13), as unwinding of the yarn (3) from the yarn supply package (5) progresses.
6. The yarn processing system according to claim 5, comprising:
 a controller (40), wherein the controller (40) is configured to control the balloon adjustment device (57) to decrease the distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), as the unwinding of the yarn (3) from the yarn supply package (5) progresses.
7. The yarn processing system according to claim 5 or 6, wherein
 in the yarn processing machine, a plurality of the processing positions (35) is provided, and a plurality of the yarn supply holders (12) and a plurality of the yarn guides (13) are provided corresponding to the plurality of the processing positions (35), respectively, and
 the work robot (50) includes a traveling device (51) and/or an elevation device to enable the balloon adjustment device to travel to positions of the plurality of the yarn supply holders (12).
8. The yarn processing system according to claim 7,

wherein

- the work robot (50) includes a package feeding device configured for setting the yarn supply package (5) for each of the plurality of the yarn supply holders (12), and
 the traveling device (51) and/or the elevation device (52) is configured to enable the package feeding device, together with the balloon adjustment device (57), to travel to the positions of the plurality of the yarn supply holders (12).
9. The yarn processing system according to any one of claims 5 to 8, wherein the balloon adjustment device (57) of the work robot (50) is configured to decrease in steps the distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), by moving in steps at least one of the yarn supply package (5) from which the yarn is being unwound and the yarn guide (13), as the unwinding of the yarn (3) from the yarn supply package (5) progresses.
10. A yarn processing system (100), comprising:
 a yarn processing machine comprising a yarn supply holder (12) on which a yarn supply package (5) wound with yarn can be set, a processing position (35) where the yarn (3) from the yarn supply package (5) set on the yarn supply holder (12) is processed to form a wind package (6) and a yarn guide (13) for guiding the yarn (3) at a downstream end of a balloon formed by the yarn (3) unwound from the yarn supply package (5) set on the yarn supply holder (12) toward the processing position (35),
 wherein one pair of the yarn supply holders (12) is provided for the processing position (35) and one yarn guide (13) which is commonly used for the pair of the yarn supply holders (12) is provided,
 wherein a during-unwinding yarn supply package detection device (16) is provided to detect which of two yarn supply packages (5) set on the two yarn supply holders (12) the yarn (3) is being unwound from; and
 a work robot (50) configured to perform work for the yarn processing machine, the work robot (50) including a balloon adjustment device (57) configured to decrease a distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), by moving at least one of the yarn supply package (5) from which the yarn is being unwound and the yarn guide (13), as unwinding of the yarn (3) from the yarn supply package (5) where the yarn (3) is detected as being unwound by the during-unwinding yarn supply package detection de-

vice (16) progresses.

11. The yarn processing system according to claim 10, comprising:
a controller (40), wherein the controller (40) is configured to control the balloon adjustment device (57) to decrease the distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), as the unwinding of the yarn (3) from the yarn supply package (5) progresses, based on a detection result of the during-unwinding yarn supply package detection device (16). 5 10

12. The yarn processing system according to claim 10 or 11, wherein 15

in the yarn processing machine, a plurality of the processing positions (35) is provided, and a plurality of the yarn supply holders (12) and a plurality of the yarn guides (13) are provided corresponding to the plurality of the processing positions (35), respectively, and 20
the work robot (50) includes a traveling device (51) and/or an elevation device to enable the balloon adjustment device (57) to travel to positions of the plurality of the yarn supply holders (12). 25

13. The yarn processing system according to claim 12, wherein 30

the work robot (50) includes a package feeding device configured for setting the yarn supply package (5) for each of the plurality of the yarn supply holders (12), and 35
the traveling device (51) and/or the elevation device (52) is configured to enable the package feeding device, together with the balloon adjustment device (57), to travel to the positions of the plurality of the yarn supply holders (12). 40

14. The yarn processing system according to any one of claims 11 to 13, wherein the balloon adjustment device (57) of the work robot (50) is configured to decrease in steps the distance between the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13), by moving in steps at least one of the yarn supply package (5) from which the yarn (3) is being unwound and the yarn guide (13) as the unwinding of the yarn from the yarn supply package (5) progresses. 45 50

15. The yarn processing system according to any one of claims 5 to 14, wherein in the yarn supply holder (12), at least a portion on which the yarn supply package (5) is set is configured for approaching and separating with respect to the yarn guide (13). 55

FIG. 1

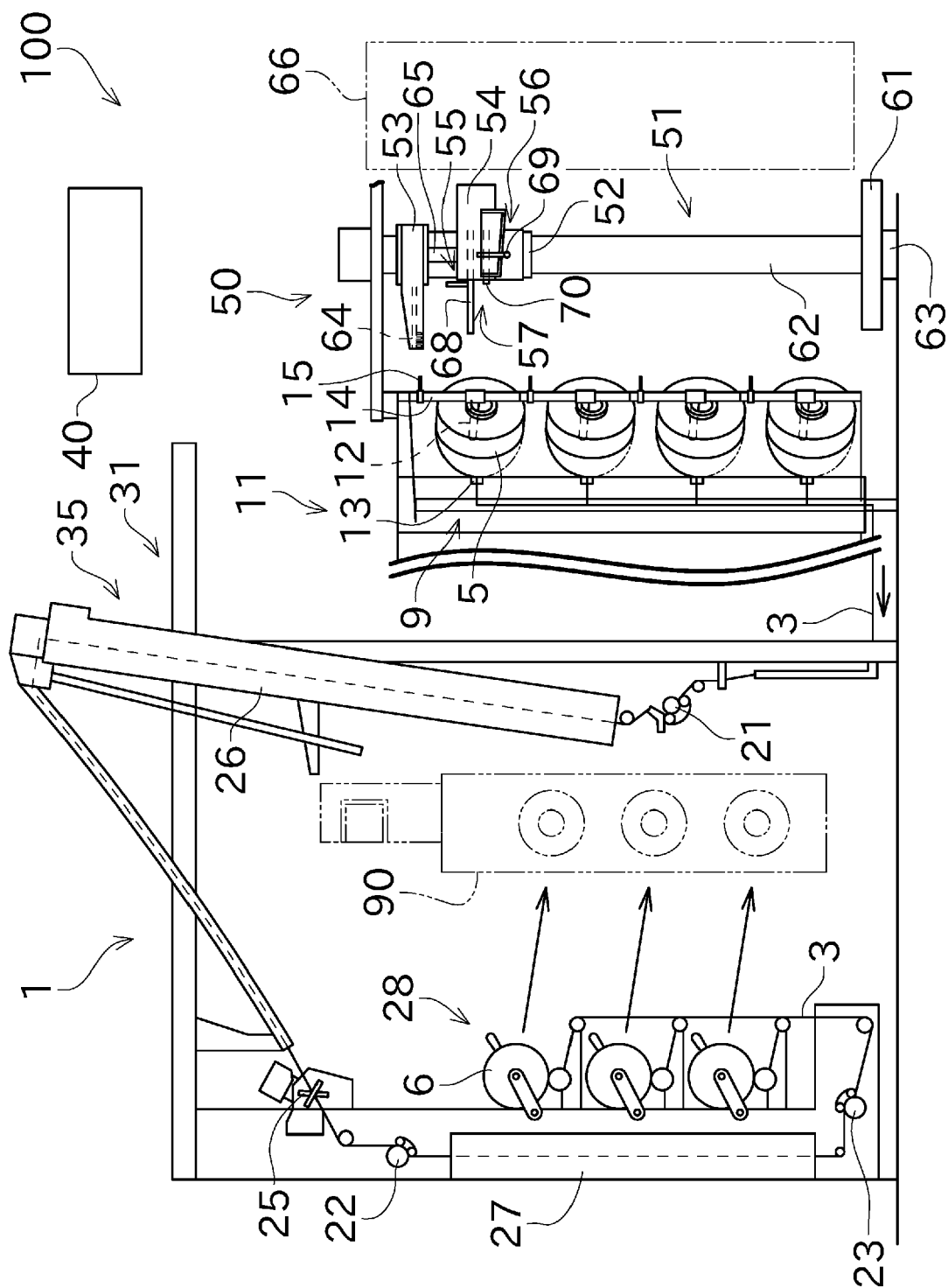


FIG. 2

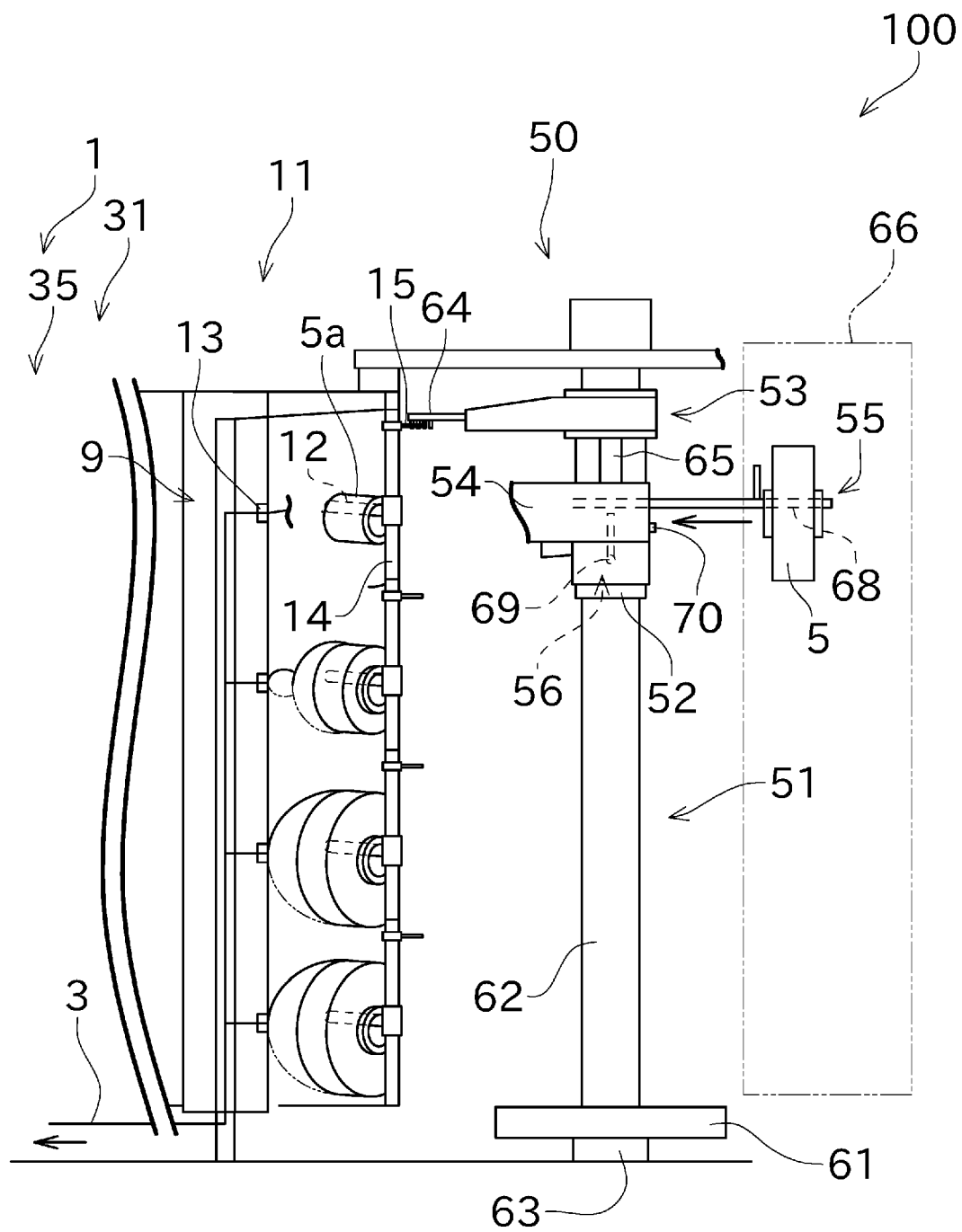


FIG. 3

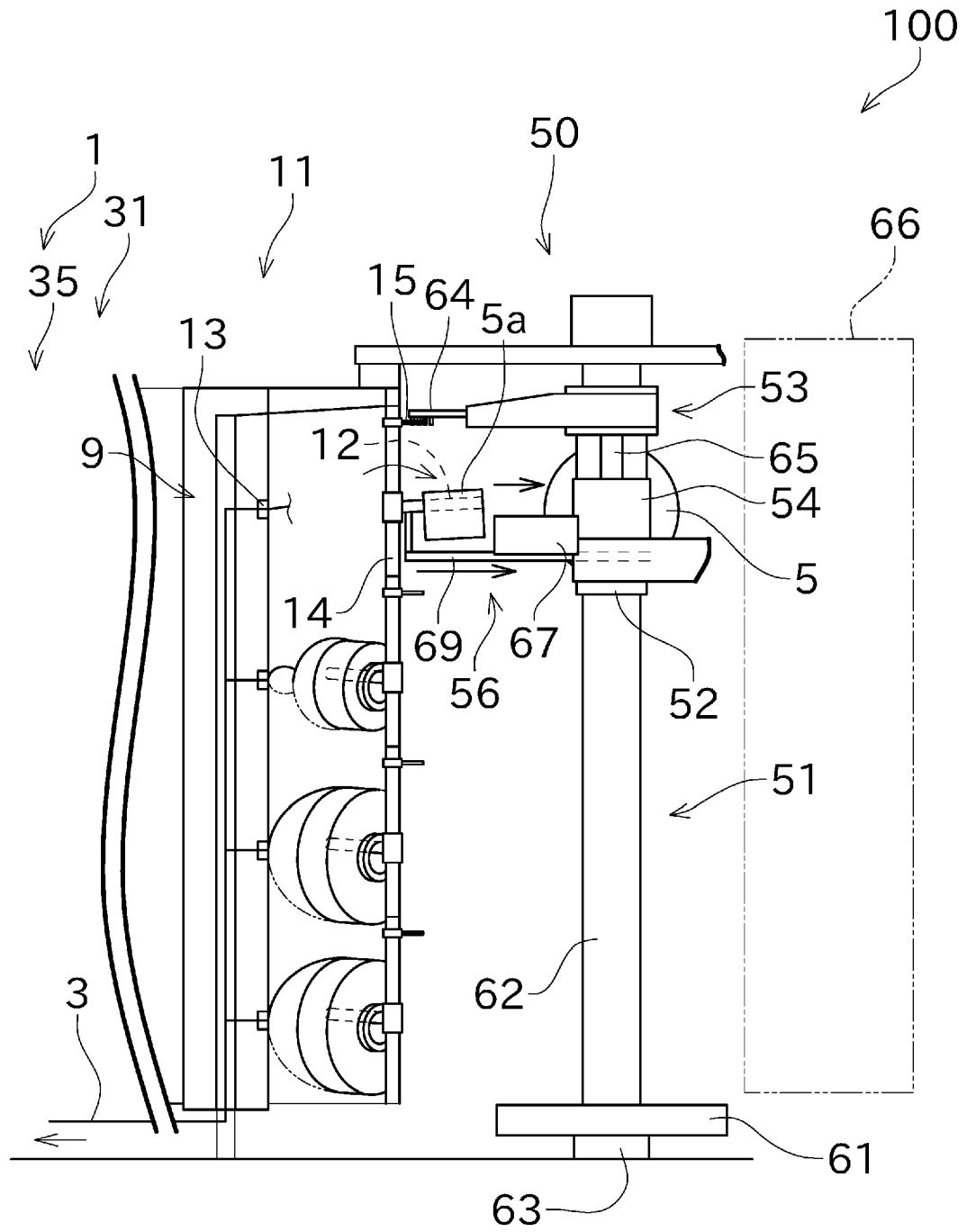


FIG. 4

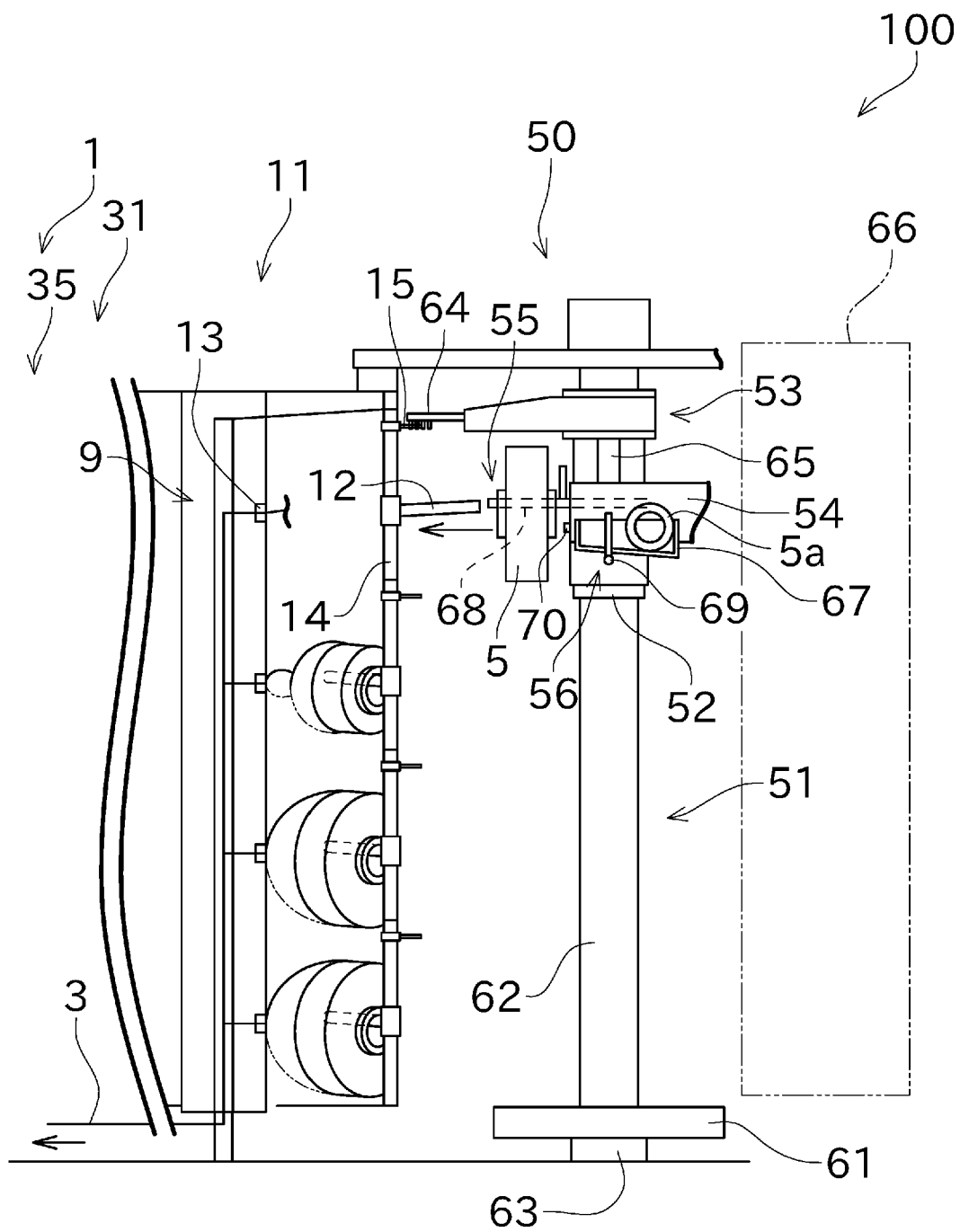


FIG. 5

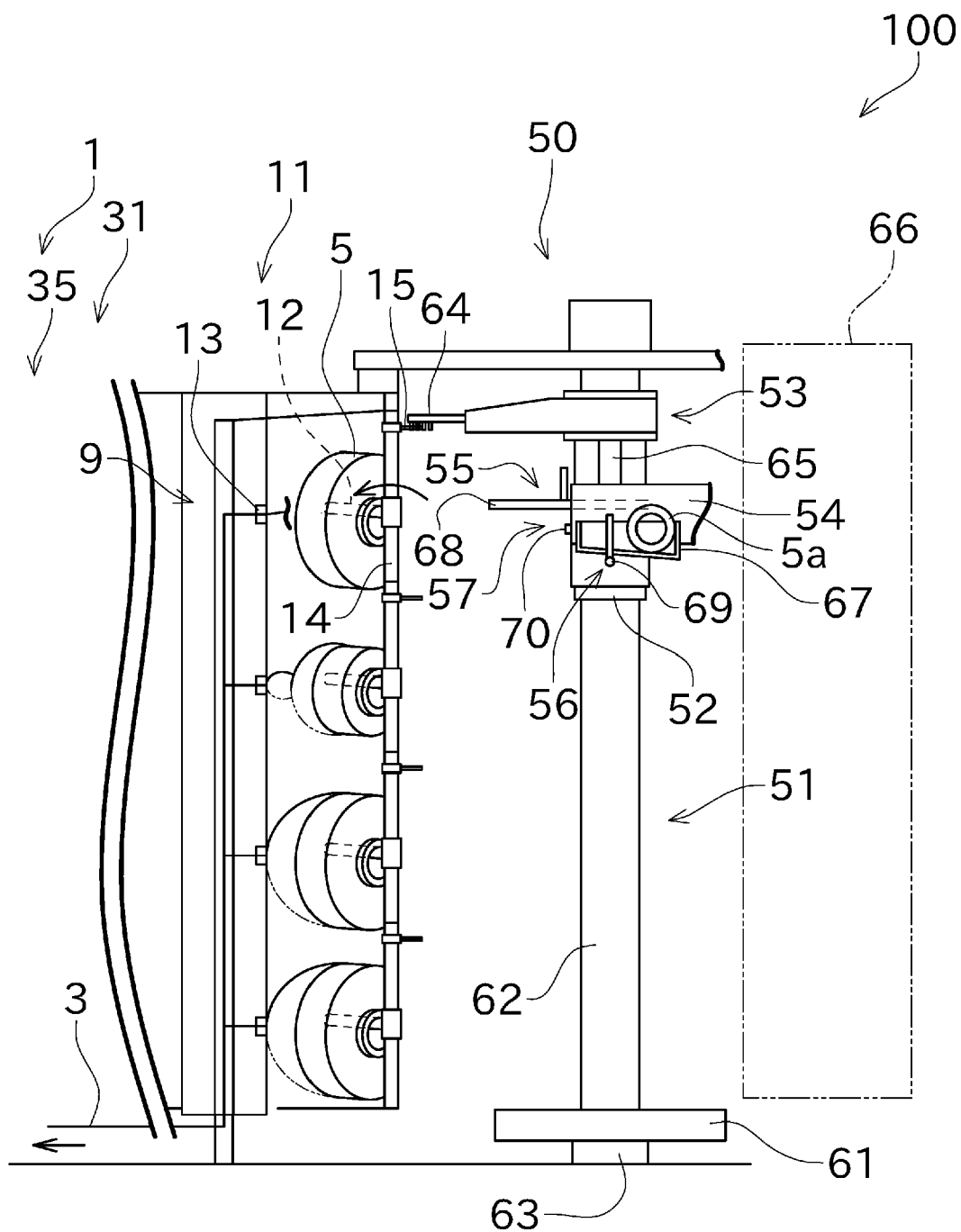


FIG. 6

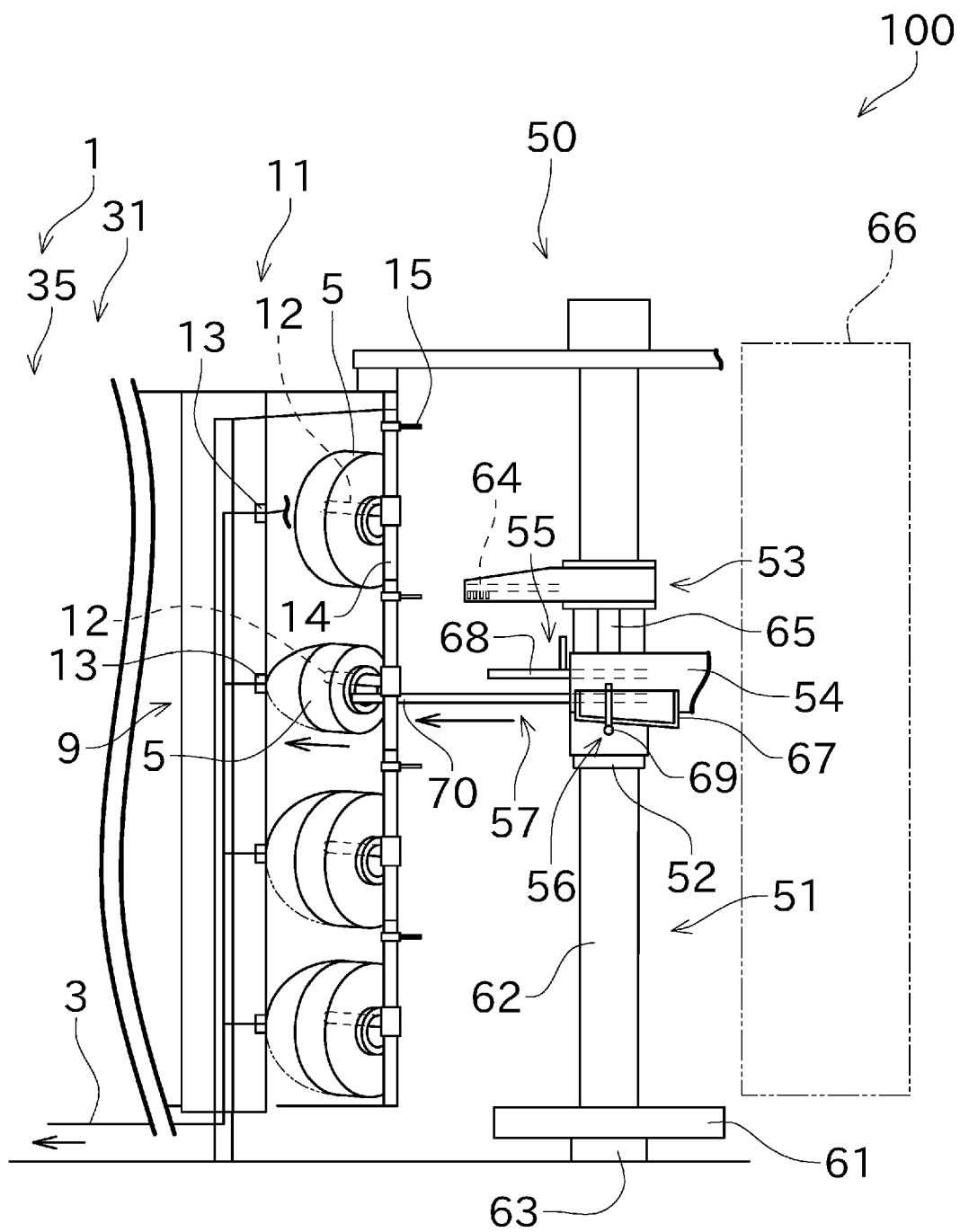


FIG. 7

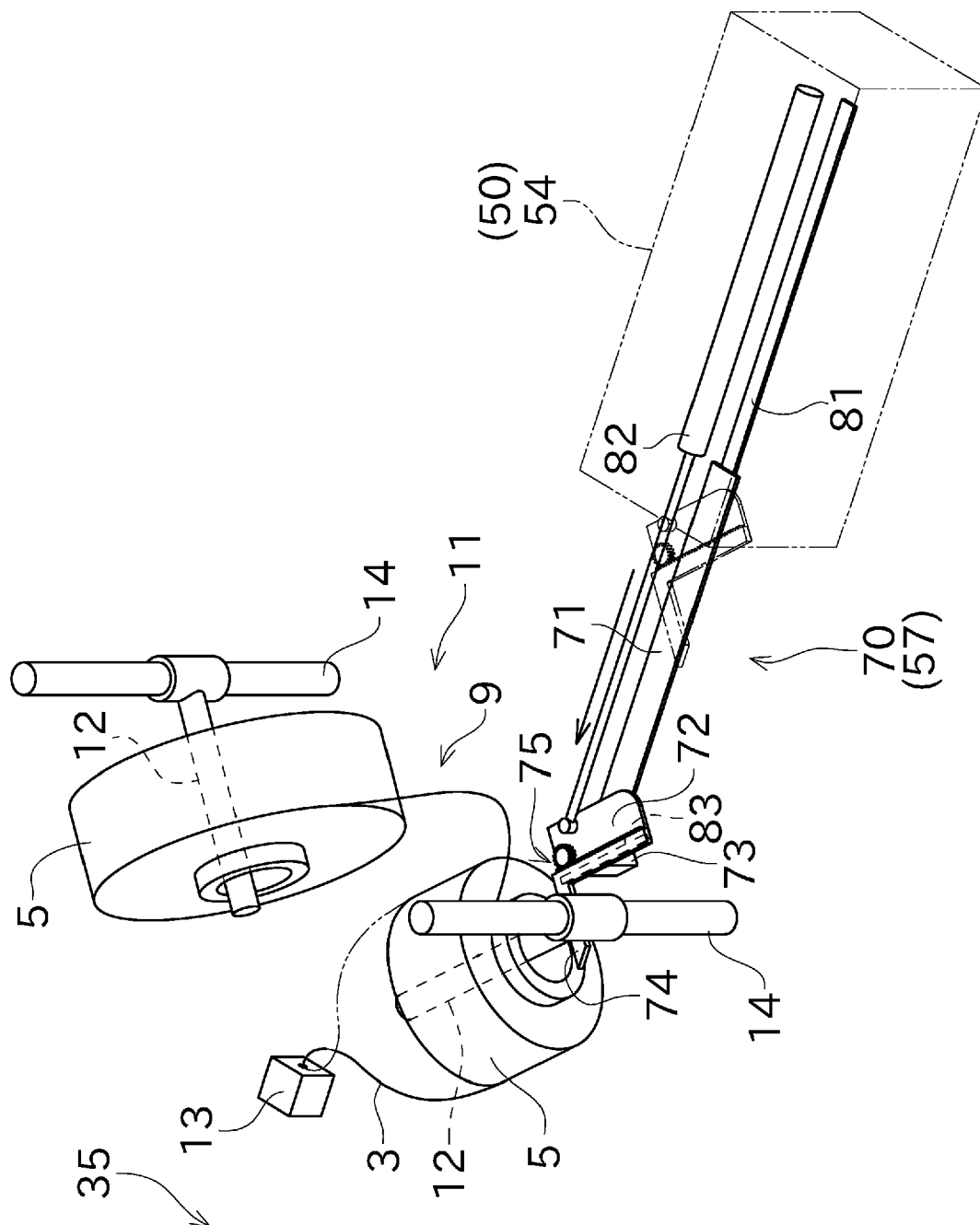


FIG. 8

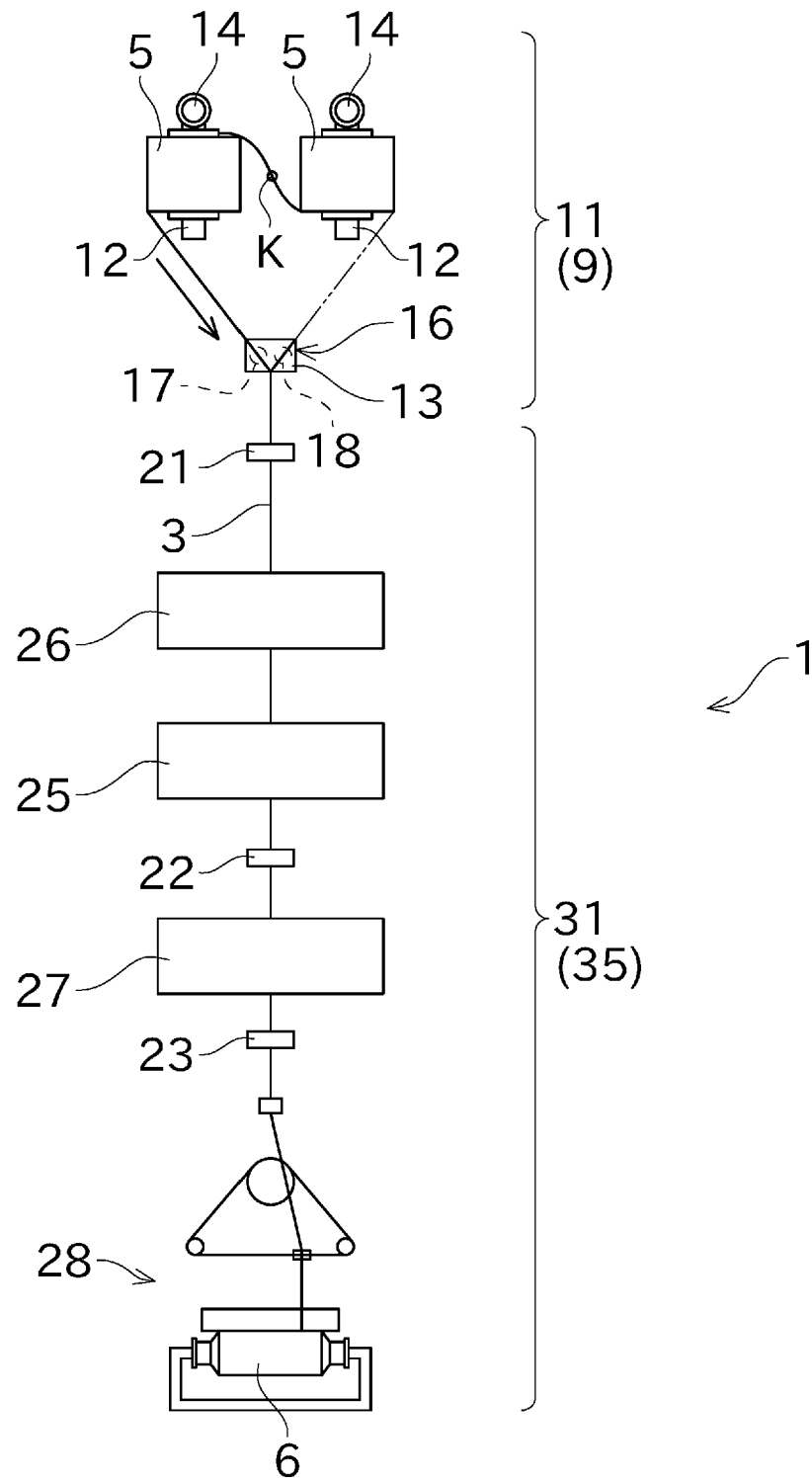


FIG. 9

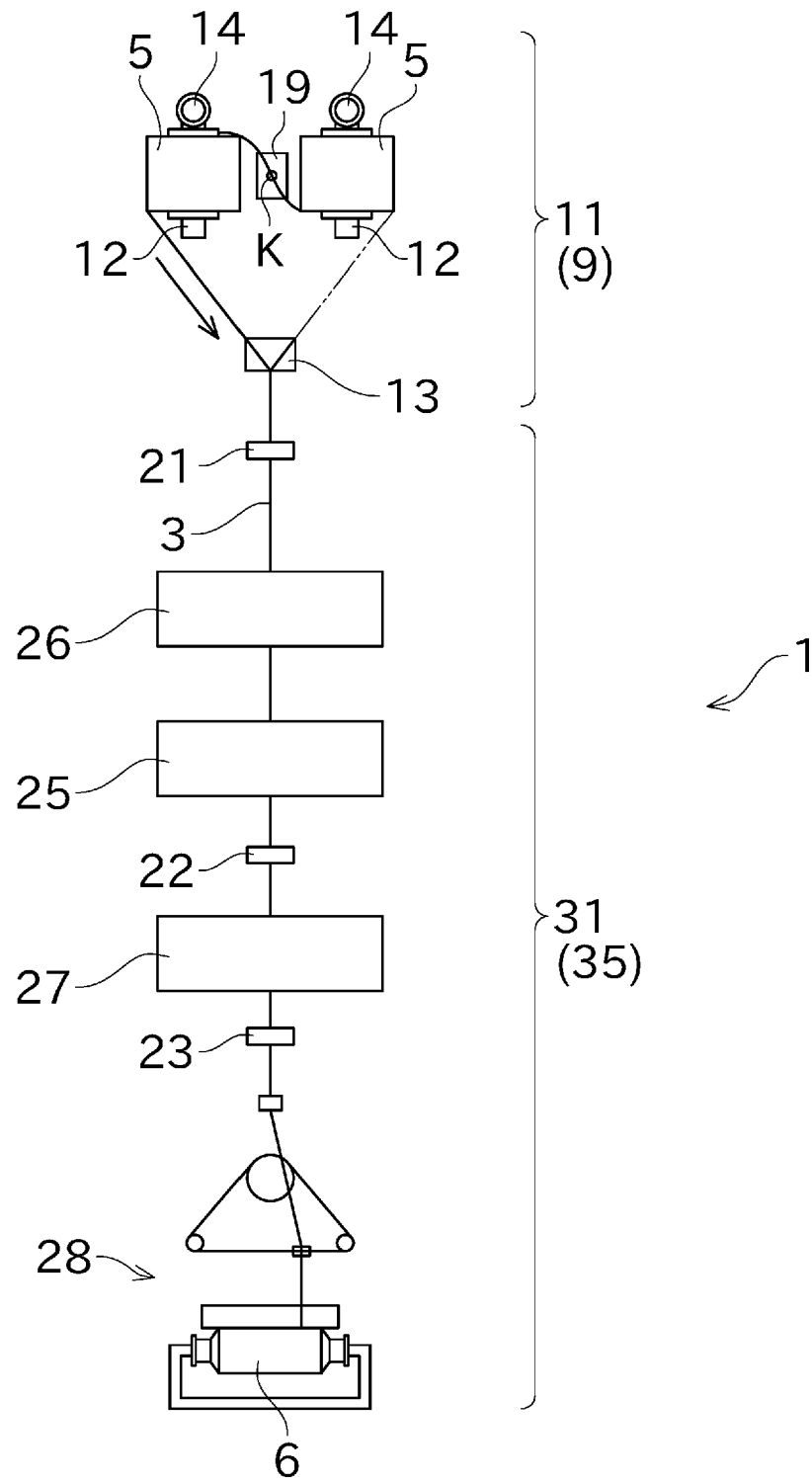
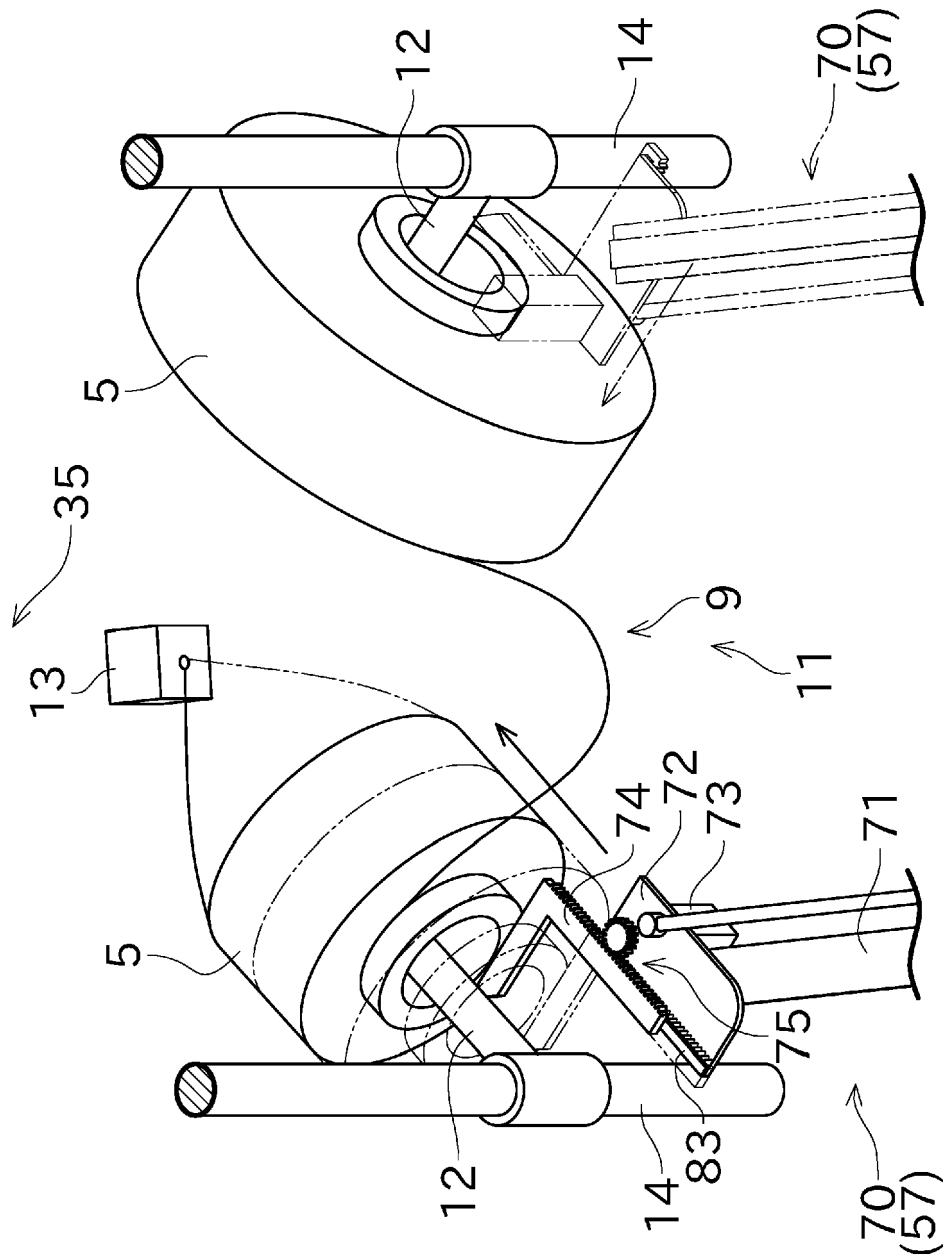


FIG. 10



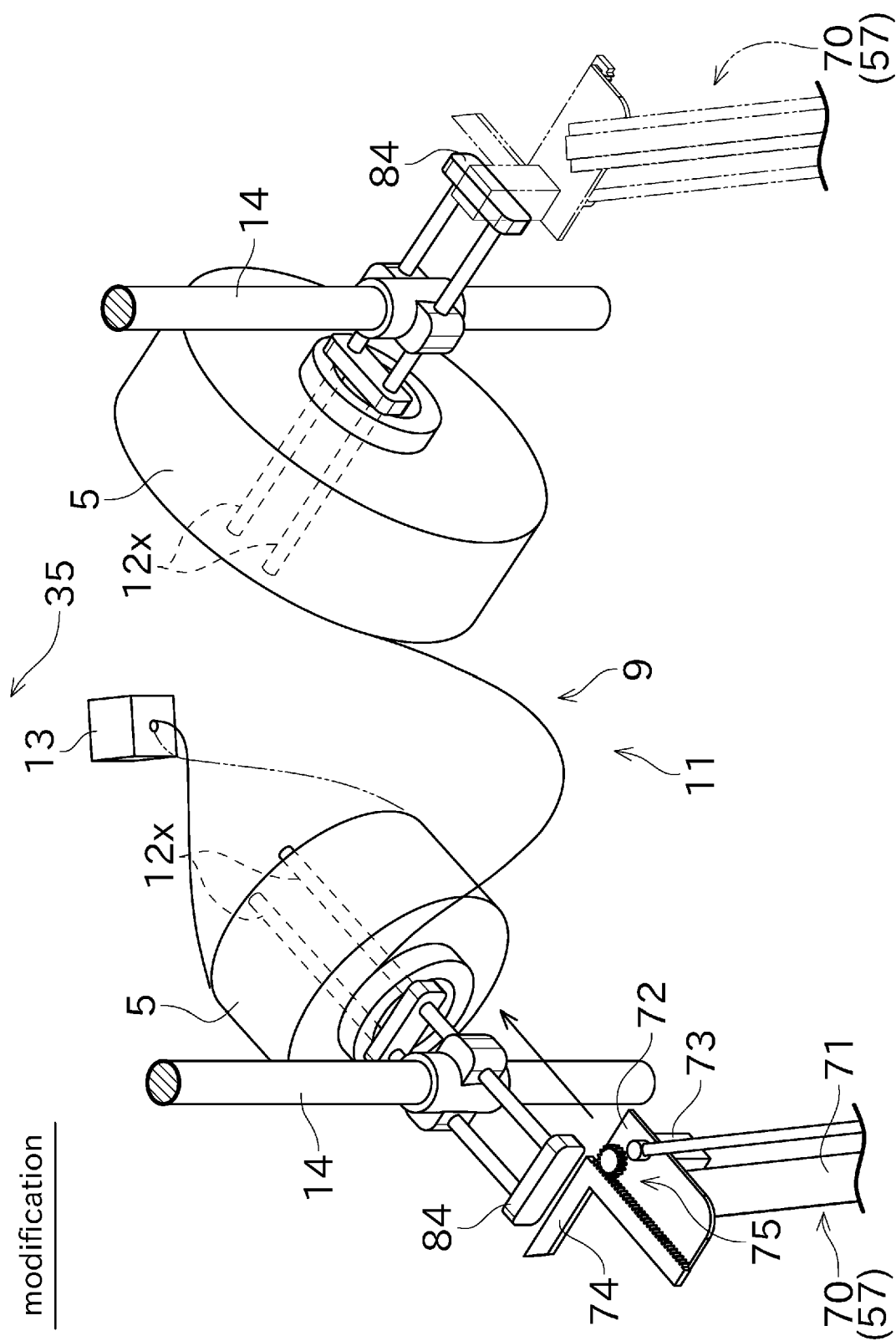


FIG. 11

modification



EUROPEAN SEARCH REPORT

Application Number

EP 23 20 5534

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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)
A	DE 34 29 153 A1 (BARMAG BARMER MASCHF [DE]) 28 February 1985 (1985-02-28) * page 9, lines 16-29 * -----	1-15	INV. B65H49/16 B65H54/26 B65H57/22
A	DE 41 15 059 A1 (BENNINGER AG MASCHF [CH]) 21 November 1991 (1991-11-21) * column 3, lines 46-56; claims 1,2 * -----	1-15	
A	WO 2018/146582 A1 (BTSR INT SPA [IT]) 16 August 2018 (2018-08-16) * page 7, line 28 - page 8, line 23 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H D02H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 February 2024	Examiner Pussemier, Bart
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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