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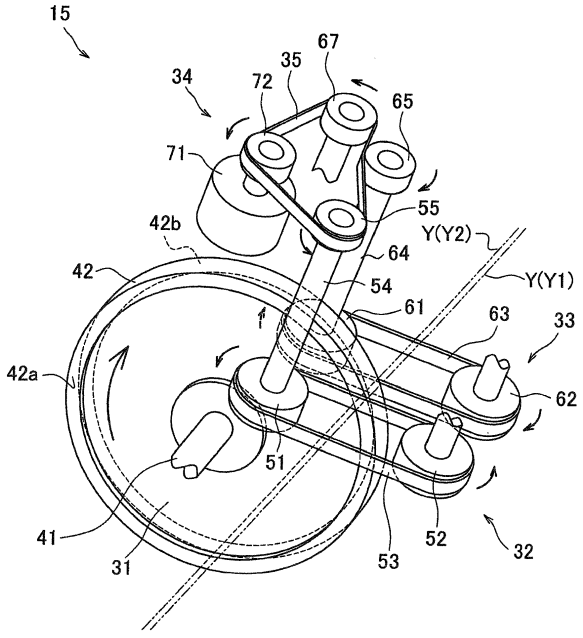
(54) DRAW TEXTURING MACHINE

(57) Problems which may occur when false-twisting devices are driven by a single driving source are solved. A draw texturing machine 1 includes a plurality of false-twisting devices 15 each configured to twist different yarns Y1 and Y2 in opposite directions to each other. Each of the false-twisting devices 15 includes: a disc configured to rotate; a belt unit 32 provided close to a first surface of the disc and including a twister belt 53 configured to allow the yarn Y1 to be interposed between the disc and the twister belt 53; a belt unit 33 provided close to a second surface of the disc and including a twister belt 63 configured to allow the yarn Y2 to be interposed between the disc and the twister belt 63; and a common motor 71 configured to drive the twister belt 53 and the twister belt 63. The above arrangement allows each motor 71 to have a smaller size as compared with cases in which the false-twisting devices 15 are driven by a large common motor. As a result, noise and vibration are reduced. Furthermore, there is no necessity to provide an element for power transmission through which the false-twisting devices 15 are driven by a common motor, and therefore downsizing of the overall draw texturing machine 1 is possible and the ease of maintenance is improved.

FIG.2



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a draw texturing machine including a plurality of false-twisting devices each configured to false-twist two running yarns in opposite directions to each other.

[0002] Patent Literature 1 (Japanese Unexamined Patent Publication No. H08-27637) discloses a so-called draw texturing and combining machine, in which each pair of false-twisted yarns, one of which is S-twisted and the other of which is Z-twisted, are combined together. In particular, each false-twisting device included in the machine of Patent Literature 1 is configured to twist the corresponding pair of yarns in S direction and Z direction, respectively, at the same time. Specifically, the false-twisting device includes a disc member configured to rotate, and two false-twisting belt units provided so that the disc member is interposed between the two belt units. Each false-twisting belt unit includes two pulleys (a driving pulley and a driven pulley), and a false-twisting belt wrapped around the two pulleys. As the false-twisting belts run on both sides of the rotating disc member in the same direction relative to the disc member, the two yarns on both sides of the disc member are twisted in the opposite directions (S direction and Z direction), respectively.

[0003] In the above-described machine, a plurality of processing units are arranged, in each of which the corresponding two yarns are combined together. In Patent Literature 1, the false-twisting devices provided for the respective processing units are driven by a large common motor provided to the machine. More specifically, a long driving belt configured to transmit the power of the motor to the false-twisting belt units of the false-twisting devices is provided so as to be runnable in a loop manner from one end portion to the other end portion, and then back to the one end portion of the machine with respect to an arrangement direction in which the false-twisting devices are arranged. Specifically, the driving belt includes a forward-running portion and a backward-running portion. Furthermore, the driving pulley of each false-twisting belt unit of each false-twisting device is connected to a pulley (connection pulley) configured to transmit the power of the motor transmitted through the driving belt. One of the two connection pulleys of each false-twisting device is in contact with the forward-running portion of the driving belt, while the other of the two connection pulleys of each false-twisting device is in contact with the backward-running portion of the belt. As the driving belt in this state runs in the arrangement direction, the driving belt rotates the two connection pulleys in opposite directions to each other.

SUMMARY OF THE INVENTION

[0004] Because the false-twisting devices described in Patent Literature 1 are driven by the single large motor, various problems may occur. For example, noise and/or vibration produced by the motor in operation are large, which may cause a noise problem or the like. Furthermore, because the false-twisting devices are driven by the common single motor, it is necessary to provide members configured to transmit the power via the long driving belt. This disadvantageously increases the size of the overall machine, and/or complicates the work of maintenance of, for example, detaching the driving belt and/or the false-twisting belts.

[0005] An object of the present invention is to solve problems which may occur when false-twisting devices are driven by a single driving source.

[0006] According to a first aspect of the invention, a draw texturing machine includes a plurality of false-twisting devices each configured to twist first and second different yarns in opposite directions to each other. Each of the false-twisting devices includes: a disc configured to rotate; a first belt unit provided close to a first surface of the disc and including a first twister belt configured to allow the first yarn to be interposed between the disc and the first twister belt; a second belt unit provided close to a second surface of the disc and including a second twister belt configured to allow the second yarn to be interposed between the disc and the second twister belt; and a common belt driving source configured to drive the first twister belt and the second twister belt.

[0007] In the above aspect of the present invention, each of the false-twisting devices of the draw texturing machine includes the common driving source configured to drive the first twister belt for twisting the first yarn and to drive the second twister belt for twisting the second yarn. That is to say, each of the false-twisting devices is independently driven by its own driving source. In this case, as compared with cases where false-twisting devices are driven by a single common motor, each driving source may have a smaller size, which drastically reduces noise and vibration made by each driving source. As a result, noise and vibration of the machine are reduced. Furthermore, there is no necessity to provide an element for power transmission through which the false-twisting devices are driven by a common motor, and therefore downsizing of the overall draw texturing machine is possible. Still further, a mechanism for power transmission is compact in the above arrangement, and this makes maintenance easier.

[0008] Furthermore, in the above aspect of the present invention, each of the false-twisting devices includes its own belt driving source, and therefore it is possible to control the false-twisting devices independently from one another. For example, when one of the false-twisting devices has to be stopped due to yarn breakage or the like, the concerned false-twisting device can be stopped merely by stopping the belt driving source of this false-twisting device.

[0009] According to a second aspect of the invention, the draw texturing machine of the first aspect is arranged

such that: the first belt unit includes a first driving pulley, a first driven pulley, and a first connection pulley, a first twister belt being wrapped around the first driving pulley and the first driven pulley, the first connection pulley being connected to the first driving pulley; the second belt unit includes a second driving pulley, a second driven pulley, and a second connection pulley, a second twister belt being wrapped around the second driving pulley and the second driven pulley, the second connection pulley being connected to the second driving pulley; a power transmission belt configured to be driven by the belt driving source is wrapped about the first connection pulley and the second connection pulley; and an inner surface of the power transmission belt is in contact with the first connection pulley, and an outer surface of the power transmission belt is in contact with the second connection pulley.

[0010] In the above aspect of the present invention, in each of the false-twisting devices, the inner surface of the power transmission belt is in contact with the first connection pulley, and the outer surface of the power transmission belt is in contact with the second connection pulley. Through this power transmission belt, the power of the belt driving source is transmitted to the first connection pulley (and the first driving pulley) and to the second connection pulley (and the second driving pulley) so that the first and second connection pulleys rotate in opposite directions to each other. As a result, the first twister belt and the second twister belt are driven, so that: the first yarn is twisted in a first direction by the first twister belt and the disc; and the second yarn is twisted in a second direction opposite to the first direction by the second twister belt and the disc. Thus, it is not necessary to use a long common belt configured to drive the false-twisting devices. Each false-twisting device is driven using a shorter belt, dimensions of which are less than those of the false-twisting device.

[0011] According to a third aspect of the invention, the draw texturing machine of the second aspect is arranged such that: an auxiliary pulley is provided so as to be opposed to the first connection pulley with the second connection pulley interposed between the auxiliary pulley and the first connection pulley; the power transmission belt is wrapped about the first connection pulley, the second connection pulley, and the auxiliary pulley; and the auxiliary pulley is in contact with the inner surface of the power transmission belt.

[0012] In the above aspect of the present invention, the second connection pulley is in contact with the outer surface of the belt, while the auxiliary pulley is in contact with the inner surface of the belt. That is, the belt is wrapped about these pulleys in S manner or in Z manner. This makes it possible to increase the wrap angle of the belt onto the second connection pulley, and thereby to increase the contact area between the belt and the second connection pulley. This reduces or minimizes the slip of the belt on the second connection pulley.

[0013] According to the fourth aspect of the invention, the draw texturing machine of the second or third aspect is arranged such that: first teeth arranged in a belt longitudinal direction are provided on the inner surface of the power transmission belt; second teeth arranged in the belt longitudinal direction are provided on the outer surface of the power transmission belt; the first connection pulley has, on its outer circumferential surface, first grooves configured to mesh with the first teeth provided on the inner surface of the power transmission belt; and the second connection pulley has, on its outer circumferential surface, second grooves configured to mesh with the second teeth provided on the outer surface of the power transmission belt.

[0014] In the above aspect of the present invention, the first teeth provided on the inner surface of the power transmission belt mesh with the first grooves of the first connection pulley, and the second teeth provided on the outer surface of the power transmission belt mesh with the second grooves of the second connection pulley. This prevents the slip of the power transmission belt on the first and second connection pulleys, and therefore the power of the belt driving source is stably transmitted to the first and second twister belts. Due to this, there is less variation in the number of twists of each yarn per unit length. This reduces the possibility that the yarns have poor quality. In addition, the above arrangement reduces variation in yarn quality among the false-twisting devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a side view of a draw texturing machine of an embodiment of the invention.

FIG. 2 is a perspective view of a false-twisting device.

FIG. 3 is a side view of the false-twisting device.

FIG. 4 is a diagram showing a plurality of false-twisting devices, viewed in a direction of an arrow IV in FIG. 3.

FIG. 5 is an explanatory diagram illustrating a driving unit and its peripheries.

FIG. 6 is an explanatory diagram illustrating a driving unit and its peripheries of a modification.

FIG. 7 is an explanatory diagram illustrating a driving unit and its peripheries of another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The following describes an embodiment of the present invention with reference to FIG. 1 to FIG. 5. In this description, the direction perpendicular to the sheet of FIG. 1 is defined as a "base longitudinal direction", and a left-right direction in the sheet is defined as a "base width direction". Naturally, the direction orthogonal to both the base longitudinal direction and the base width direction is a vertical direction in which gravity attracts objects. Furthermore, for the sake of convenience, the

front side in the sheet of FIG. 1 is defined as a "front side in the base longitudinal direction", and the rear side in the sheet is defined as a "rear side in the base longitudinal direction".

(Overall Structure of Draw Texturing Machine)

[0017] First of all, the overall structure of a draw texturing machine is described with reference to FIG. 1. FIG. 1 is a side view of a draw texturing machine 1 of the present embodiment.

[0018] The draw texturing machine 1 of the present embodiment is configured to false-twist yarns Y supplied from yarn supply packages Q such that one of each pair of yarns Y is S-twisted (twisted in S direction) and the other is Z-twisted (twisted in Z direction), then to combine each pair of yarns Y together, and to wind the obtained yarns into packages P. As shown in FIG. 1, the draw texturing machine 1 includes a yarn supplying unit 2, a processing unit 3, and a winding unit 4. The yarn supplying unit 2 is configured to supply yarns Y. The processing unit 3 is configured to false-twist the yarns Y supplied from the yarn supplying unit 2. The winding unit 4 is configured to wind the yarns Y false-twisted in the processing unit 3 to form packages P. Each of the yarn supplying unit 2, processing unit 3, and winding unit 4 has a plurality of unit sections, which will be detailed later. These unit sections are arranged in the base longitudinal direction which is orthogonal to a yarn running plane (the sheet of FIG. 1) on which a yarn path from the yarn supplying unit 2 to the winding unit 4 via the processing unit 3 extends.

[0019] The yarn supplying unit 2 includes creel stands 10 each configured to support yarn supply packages Q, and is configured to supply the yarns Y to the processing unit 3. The processing unit 3 includes: first feed rollers 11; twist-stopping guides 12; first heating devices 13; cooling devices 14; false-twisting devices 15; second feed rollers 16; combining devices 17, third feed rollers 18, second heating devices 19; and fourth feed rollers 20. These members are arranged in this order from an upstream side in a yarn running direction, in which the yarns Y run. The winding unit 4 is configured to wind the yarns Y false-twisted in the processing unit 3 by winding devices 21, to form packages P.

[0020] The draw texturing machine 1 includes main frames 5 arranged in a row and winding bases 6 arranged in rows so as to be apart from the main frames 5 in the base width direction. The row of the main frames 5 and the rows of the winding bases 6 have the substantially same length in the base longitudinal direction. Each winding base 6 is opposed to the corresponding main frame 5. An upper portion of each winding base 6 is connected with an upper portion of the corresponding main frame 5 by a supporting frame 7. Devices constituting the processing unit 3 are mainly attached to the main frames 5 or to the supporting frames 7. The main frames 5, the winding bases 6, and the supporting frames 7 define a working space 8. The yarn path is formed so that yarns Y mainly run around the working space 8.

[0021] The draw texturing machine 1 has unit sections called spans. Each span includes one main frame 5 and one winding base 6 as a pair, which are opposed to each other. In each span, devices are arranged so that the yarns Y running while being arranged side by side in the base longitudinal direction can be false-twisted simultaneously. In the draw texturing machine 1, spans are arranged in rows extending in the base longitudinal direction so that the rows are symmetrical with respect to a center line C of the main frames 5 (the center line with respect to the base width direction). Each main frame 5 is shared with the spans on its both sides.

(Structure of Processing Unit)

[0022] The following describes the structure of the processing unit 3.

[0023] The first feed rollers 11 are configured to feed the yarns Y supplied from the yarn supplying unit 2 to the first heating devices 13. Each first feed roller 11 is provided at an upper portion of the corresponding winding base 6. Each first feed roller 11 includes unillustrated pairs of drive and driven rollers respectively provided for the yarns Y. The drive rollers and driven rollers are arranged in rows, respectively, in the base longitudinal direction.

[0024] Each twist-stopping guide 12 is configured to prevent propagation of the twist of the corresponding yarn Y, which is imparted by the later-described false-twisting device 15, to a portion upstream of the twist-stopping guide 12 in the yarn running direction. The twist-stopping guides 12 are provided downstream of the first feed rollers 11 in the yarn running direction and upstream of the first heating devices 13 in the yarn running direction. The twist-stopping guides 12 are provided respectively for the yarns Y supplied from the yarn supplying unit 2, and are aligned in the base longitudinal direction.

[0025] The first heating devices 13 are configured to heat the yarns Y fed from the first feed rollers 11, and are provided onto the supporting frames 7. Each first heating device 13 is inclined with respect to the base width direction so that its downstream end in the yarn running direction is lower than its upstream end in the yarn running direction. The twist-stopping guides 12, the cooling devices 14, and the false-twisting devices 15 are provided substantially along a direction in which the first heating devices 13 extend. The first heating devices 13 are provided for the yarns Y supplied from the yarn supplying unit 2, and are aligned in the base longitudinal direction.

[0026] The cooling devices 14 are configured to cool the yarns Y heated by the first heating devices 13. The cooling devices 14 are provided downstream of the first heating devices 13 in the yarn running direction and upstream of the false-twisting devices 15 in the yarn running direction. The cooling devices 14 are provided respectively for the yarns Y supplied from the yarn supplying

unit 2, and are aligned in the base longitudinal direction.

[0027] Each false-twisting device 15 is provided at an upper portion of the corresponding main frame 5, and is configured to twist a corresponding pair of yarns Y (yarns Y1 and Y2) out of the yarns Y in opposite directions. Specifically, the false-twisting device 15 twists one of the pair of yarns Y in S direction, and twists the other of the pair of yarns Y in Z direction. The yarn Y1 is equivalent to a "first yarn" in the present invention, while the yarn Y2 is equivalent to a "second yarn" in the present invention. The false-twisting devices 15 are arranged in the base longitudinal direction. The details of the false-twisting devices 15 will be described later.

[0028] The second feed rollers 16 are configured to feed the yarns Y treated by the false-twisting devices 15 to the combining devices 17. The second feed rollers are provided below the false-twisting devices 15, in the main frames 5. Each second feed roller 16 includes unillustrated pairs of drive and driven rollers respectively provided for the yarns Y. The drive rollers and driven rollers are arranged in rows, respectively, in the base longitudinal direction. The conveyance speed at which the second feed rollers 16 convey the yarns Y is higher than the conveyance speed at which the first feed rollers 11 convey the yarns Y, and therefore the yarns Y are drawn between the first feed rollers 11 and the second feed rollers 16.

[0029] Each combining device 17 is configured to combine the corresponding yarns Y1 and Y2 together. The combining devices 17 are provided below the second feed rollers 16, in the main frames 5. Each combining device 17 is configured, for example, to eject air to the corresponding yarns Y1 and Y2, thereby to combine the yarns Y1 and Y2 through air entanglement (air interlacing), in which filaments of the yarns Y1 and Y2 are entangled by air jets. The combining devices 17 are provided so as to correspond to the false-twisting devices 15 in number, i.e., on a one-to one basis.

[0030] The third feed rollers 18 are configured to feed the yarns Y combined in the combining devices 17 to the second heating devices 19. The third feed rollers 18 are provided below the combining devices 17, in the main frames 5. Each third feed roller 18 includes unillustrated pairs of drive and driven rollers respectively provided for the pairs of yarns Y combined in the combining devices 17. The drive rollers and driven rollers are arranged in rows, respectively, in the base longitudinal direction. The conveyance speed at which the third feed rollers 18 convey the yarns Y is lower than the conveyance speed at which the second feed rollers 16 convey the yarns Y, and therefore the yarns Y are relaxed between the second feed rollers 16 and the third feed rollers 18.

[0031] The second heating devices 19 are configured to heat the yarns Y fed by the third feed rollers 18, and are provided below the third feed rollers 18, in the main frames 5. Each second heating device 19 extends in the vertical direction. Each span has one second heating device 19.

[0032] The fourth feed rollers 20 are configured to feed the yarns Y heated by the second heating devices 19 to the winding devices 21. Each fourth feed roller 20 is provided at a lower portion of the corresponding winding base 6. Each fourth feed roller 20 includes unillustrated pairs of drive and driven rollers respectively provided for the yarns Y heated by the second heating devices 19. The drive rollers and driven rollers are arranged in rows, respectively, in the base longitudinal direction. The conveyance speed at which the fourth feed rollers 20 convey the yarns Y is lower than the conveyance speed at which the third feed rollers 18 convey the yarns Y, and therefore the yarns Y are relaxed between the third feed rollers 18 and the fourth feed rollers 20.

[0033] In the processing unit 3 structured as above, each of the pairs of yarns Y, which have been drawn between the first feed rollers 11 and the second feed rollers 16, are twisted by the corresponding false-twisting device 15. Twists imparted by each false-twisting device 15 are propagated to the corresponding twist-stopping guide 12, however, the twists are not propagated to the portion upstream of the twist-stopping guide 12 in the yarn running direction. The yarns Y twisted while being drawn are heated in the first heating devices 13 to be heat-set, and then cooled in the cooling devices 14. The yarns Y are untwisted on the downstream side from the false-twisting devices 15. However, due to the above-mentioned heat-setting, the filaments of the yarns Y retain a false-twisted wavy state. Then, each pair of yarns Y (yarn Y1 and yarn Y2) false-twisted (S-twisted and Z-twisted) by the corresponding false-twisting device 15 are combined together by the corresponding combining device 17, while being relaxed between the second feed rollers 16 and the third feed rollers 18. The combined pairs of yarns Y are heat-set in the second heating devices 19 while being relaxed between the third feed rollers 18 and the fourth feed rollers 20. Finally, the yarns Y fed by the fourth feed rollers 20 are wound by the winding devices 21, so that packages P are formed.

(Detailed Structure of False-Twisting Device)

[0034] Now, the detailed structure of each false-twisting device 15 is described with reference to FIG. 2 to FIG. 5. FIG. 2 is a perspective view of the false-twisting device 15. FIG. 3 is a side view of the false-twisting device 15 viewed in the base longitudinal direction. FIG. 4 is a diagram showing the false-twisting devices 15, viewed in a direction of an arrow IV in FIG. 3. FIG. 5 is an explanatory diagram illustrating a part of the false-twisting device 15, the part including a later-described driving unit 34 and its peripheries.

[0035] The false-twisting devices 15 are arranged in the base longitudinal direction (see FIG. 4). Each false-twisting device 15 is configured to twist the corresponding pair of different yarns Y (yarns Y1 and Y2) in opposite directions (S direction and Z direction). In other words, one of the pair of yarns Y is S-twisted, and the other of

the pair of yarns Y is Z-twisted. Each false-twisting device 15 has the following structure in order to twist the yarn Y1 and yarn Y2 in the opposite directions. Specifically, as shown FIG. 2, the false-twisting device 15 includes: a rotatable disc 31; a belt unit 32 ("first belt unit" in the present invention) provided on a front side in the base longitudinal direction relative to the disc 31 ("close to a first surface of the disc" in the present invention); a belt unit 33 ("second belt unit" in the present invention) provided on a rear side in the base longitudinal direction relative to the disc 31 ("close to a second surface of the disc" in the present invention); and a driving unit 34 configured to drive a later-described twister belt 53 ("first twister belt" in the present invention) of the belt unit 32 and to drive a later-described twister belt 63 ("second twister belt" in the present invention) of the belt unit 33, as main components.

[0036] The disc 31 is provided between the yarns Y1 and Y2 running through the false-twisting device 15. The yarn Y1 is located on the front side relative to the disc 31 in the base longitudinal direction while the yarn Y2 is located on the rear side relative to the disc 31 in the base longitudinal direction (see FIG. 3 and FIG. 4). A ring portion 42 is provided at an outer circumferential portion of the disc 31. The ring portion 42 is configured to twist the yarns Y1 and Y2 in cooperation with the twister belts 53 and 63. The ring portion 42 is made of material having wear resistance equal to or higher than that of the twister belts 53 and 63. A ring surface 42a is provided on a front surface of the ring portion 42, which is on the front side in the base longitudinal direction. The ring surface 42a is in contact with a part of an outer surface of the twister belt 53. Furthermore, a ring surface 42b is provided on a rear surface of the ring portion 42, which is on the rear side in the base longitudinal direction. The ring surface 42b is in contact with a part of an outer surface of the twister belt 63.

[0037] The disc 31 is attached to a shaft 41 extending along the base longitudinal direction. The shaft 41 extends in the base longitudinal direction, for example, so as to be shared among a plurality of false-twisting devices 15. To the shaft 41, the discs 31 of the false-twisting devices 15 are attached, and the shaft 41 is connected to a single motor (not illustrated). As the motor rotates, the discs 31 of the false-twisting devices 15 rotate about the shaft 41.

[0038] The belt unit 32 is configured to twist (Z-twist, in the present embodiment) the yarn Y1 interposed between the belt unit 32 and the disc 31. The belt unit 32 is provided on the front side relative to the disc 31 in the base longitudinal direction. The belt unit 32 includes: a pulley 51 ("first driving pulley" in the present invention) and a pulley 52 ("first driven pulley" in the present invention); the twister belt 53; a shaft 54 with its one end portion fixed to the pulley 51; and a pulley 55 ("first connection pulley" in the present invention) fixed to the shaft 54.

[0039] Each of the pulleys 51 and 52 is configured to be rotatable about a rotational axis direction which is orthogonal to the base longitudinal direction. The pulley 51 and the pulley 52 are arranged in a direction orthogonal to the above rotational axis direction and to the base longitudinal direction.

[0040] The twister belt 53 is an endless belt, and is wrapped around the pulley 51 and the pulley 52. The yarn Y1 is between: a portion of the twister belt 53 which is not in contact with the pulleys 51 and 52 and is closer to the disc 31 in the base longitudinal direction; and the ring portion 42 of the disc 31.

[0041] The one end portion of the shaft 54 is fixed to the pulley 51. The shaft 54 extends in the rotational axis direction of the pulley 51. The shaft 54 extends obliquely in such a manner that its end closer to the working space 8 (see FIG. 1) in the base width direction is located higher than the farther end.

[0042] The pulley 55 is fixed to the other end portion of the shaft 54, and is connected to the pulley 51 via the shaft 54. On an outer circumferential surface of the pulley 55, a plurality of grooves 56 ("first grooves" in the present invention) each extending in the rotational axis direction of the pulley 55 are arranged at substantially equal intervals in the circumferential direction of the pulley 55 (see FIG. 5).

[0043] The belt unit 33 is configured to twist the yarn Y2 in the direction opposite to that of the yarn Y1 (in S direction in the present embodiment) while holding the yarn Y2 between the belt unit 33 and the disc 31. The belt unit 33 is positioned so as to be opposed to the belt unit 32 with the disc 31 interposed between them. That is, the belt unit 33 is provided on the rear side relative to the disc 31 in the base longitudinal direction. The structure of the belt unit 33 is similar to that of the belt unit 32 which has been described above. Specifically, the belt unit 33 includes: a pulley 61 ("second driving pulley" in the present invention) and a pulley 62 ("second driven pulley" in the present invention); the twister belt 63 wrapped around the pulleys 61 and 62; a shaft 64 with its one end portion fixed to the pulley 61; and a pulley 65 ("second connection pulley" in the present invention) fixed to the other end portion of the shaft 64. The yarn Y2 is interposed between the twister belt 63 and the ring portion 42. On an outer circumferential surface of the pulley 65, a plurality of grooves 66 ("second grooves" in the present invention) each extending in the rotational axis direction of the pulley 65 are arranged at substantially equal intervals in the circumferential direction of the pulley 65 (see FIG. 5).

[0044] A pulley 67 ("auxiliary pulley" in the present invention) is rotatably provided so as to be opposed to the pulley 55 with the pulley 65 interposed between the pulleys 67 and 55 in the base longitudinal direction (see FIG. 5). On an outer circumferential surface of the pulley 67, a plurality of grooves 68 each extending in the rotational axis direction of the pulley 67 are arranged at substantially equal intervals in the circumferential direction of the pulley 67 (see FIG. 5).

[0045] The driving unit 34 is configured to drive both

the twister belt 53 and the twister belt 63. Each false-twisting device 15 is provided with its own driving unit 34. As shown in FIG. 3, the driving unit 34 is provided, for example, above the disc 31. The driving unit 34 includes: a motor 71 ("belt driving source" in the present invention) functioning as a power source; and a pulley 72 connected to a rotation shaft of the motor 71. The rotation shaft of the motor 71 extends obliquely upward toward the working space 8. The pulley 72 is provided obliquely above the motor 71. In the other words, the motor 71 is provided between the disc 31 and the pulley 72. On an outer circumferential surface of the pulley 72, a plurality of grooves 73 each extending in the rotational axis direction of the pulley 72 are arranged at substantially equal intervals in the circumferential direction of the pulley 72 (see FIG. 5).

[0046] As shown in FIG. 5, a belt 35 ("power transmission belt" in the present invention) is wrapped about the pulleys 55, 65, 67, and 72. The belt 35 is an endless belt configured to transmit the power from the driving unit 34 to the pulley 55 and the pulley 65. The inner surface of the belt 35 is in contact with the pulleys 55, 67, and 72, and the outer surface of the belt 35 is in contact with the pulley 65. As shown in FIG. 5, on the inner surface of the belt 35, teeth 75 ("first teeth" in the present invention) are arranged at substantially equal intervals in the longitudinal direction of the belt 35. Meanwhile, on the outer surface of the belt 35, teeth 76 ("second teeth" in the present invention) are arranged at substantially equal intervals in the longitudinal direction of the belt 35. The teeth 75 on the inner surface of the belt 35 are configured to mesh with the grooves 56, 68, and 73 of the pulleys 55, 67, and 72. The teeth 76 on the outer surface of the belt 35 are configured to mesh with the grooves 66 of the pulley 65.

[0047] The following describes the operation of the false-twisting device 15 having the above-described structure. First of all, as shown in FIG. 2, the disc 31 is driven and rotated about the shaft 41 by an unillustrated motor in a direction indicated by an arrow (in a clockwise direction in FIG. 2).

[0048] Now, a description will be given for the operation of the belt unit 32 and the belt unit 33, with reference to FIG. 2 and FIG. 5. As shown in FIG. 5, when the rotation shaft of the motor 71 of the driving unit 34 rotates in a predetermined direction (in a counterclockwise direction in FIG. 5), the power of the motor 71 is transmitted to the pulley 55 of the belt unit 32, the pulley 65 of the belt unit 33, and the pulley 67, via the pulley 72 connected to the motor 71 and via the belt 35 wrapped about the pulley 72. Now, because all the pulleys 55, 67, and 72 are in contact with the inner surface of the belt 35, these pulleys rotate in the same direction (in the counterclockwise direction in FIG. 5). Meanwhile, because the pulley 65 is in contact with the outer surface of the belt 35, the power of the motor 71 is transmitted to the pulley 65 in the direction opposite to that for the pulleys 55 and the like. That is, the pulley 65 rotates in the direction opposite to the rotation direction of the pulleys 55 and the like, i.e., the pulley 65 rotates in the clockwise direction in FIG. 5. Note that the teeth 75 of the belt 35 mesh with the grooves 56, 68, and 73 of the pulleys 55, 67, and 72, respectively, and the teeth 76 of the belt 35 mesh with the grooves 66 of the pulley 65. This prevents the slip of the belt 35 on the pulleys 55 and the like.

[0049] As the pulleys 55 and 65 rotate as described above, the pulley 51 rotates together with the pulley 55, and the pulley 61 rotates together with the pulley 65. As shown in FIG. 3, the pulley 55 and the pulley 65 rotate in the opposite directions to each other, and therefore the pulley 51 and pulley 61 rotate in the opposite directions to each other. As a result, the power is transmitted to the twister belt 53 and to the twister belt 63. Now, a portion of the twister belt 53 and a portion of the twister belt 63, which are close to the disc 31, run in the same direction relative to the disc 31. The pulleys 52 and 62 are rotated in a slave manner as the respective twister belts 53 and 63 are driven.

[0050] As the yarn Y1 is between the ring portion 42 of the rotating disc 31 and the running twister belt 53, the yarn Y1 is Z-twisted. Meanwhile, as the yarn Y2 is between the ring portion 42 and the twister belt 63, the yarn Y2 is S-twisted. That is, the yarn Y1 and the yarn Y2 are twisted in the opposite directions to each other.

[0051] As described above, each of the false-twisting devices 15 includes the motor 71 configured to drive the twister belt 53 for twisting the yarn Y1 and to drive the twister belt 63 for twisting the yarn Y2. That is to say, each of the false-twisting devices 15 is independently driven by its own motor 71. In this case, as compared with cases where the false-twisting devices 15 are driven by a single common motor, each motor 71 may have a smaller size, which drastically reduces noise and vibration made by each motor 71. As a result, noise and vibration of the machine are reduced. Furthermore, there is no necessity to provide an element for power transmission through which the false-twisting devices 15 are driven by a common motor, and therefore downsizing of the overall draw texturing machine 1 is possible. Still further, a mechanism for power transmission is compact in the above arrangement, and this makes maintenance easier.

[0052] Furthermore, each of the false-twisting devices 15 includes its own motor 71, and therefore it is possible to control the false-twisting devices 15 independently from one another. For example, when one of the false-twisting devices 15 has to be stopped due to yarn breakage or the like, the concerned false-twisting device 15 can be stopped merely by stopping the motor 71 of this false-twisting device 15. That is, it is possible to stop any false-twisting device 15 individually without a mechanism configured to separate the pulleys 55 and 65 from the belt 35, and this simplifies the structure of the false-twisting device 15. Furthermore, it is possible to make a difference in the speed at which the yarns Y1 and Y2 are twisted among the false-twisting devices 15, by making a difference in the running speed of the twister belts 53

and 63 among the false-twisting devices 15 by changing the outputs of the motors 71. This enables production of different types of yarns Y in the draw texturing machine 1.

[0053] In each of the false-twisting devices 15, the inner surface of the belt 35 is in contact with the pulley 55, and the outer surface of the belt 35 is in contact with the pulley 65. Through this belt 35, the power of the motor 71 is transmitted to the pulley 55 (and the pulley 51) and to the pulley 65 (and the pulley 62) so that the pulleys 55 and 65 rotate in opposite directions to each other. As a result, the twister belt 53 and the twister belt 63 are driven, so that: the yarn Y1 is twisted in a first direction by the twister belt 53 and the disc 31; and the yarn Y2 is twisted in a second direction opposite to the first direction by the twister belt 63 and the disc 31. Thus, it is not necessary to use a long common belt to drive the false-twisting devices 15. Each false-twisting device 15 is driven using the shorter belt 35, dimensions of which are less than those of the false-twisting device 15.

[0054] Furthermore, the pulley 65 is in contact with the outer surface of the belt 35, and the pulley 67 is in contact with the inner surface of the belt 35. That is, the belt 35 is wrapped about these pulleys in S manner or in Z manner. This makes it possible to increase the wrap angle of the belt 35 onto the pulley 65, and thereby to increase the contact area between the belt 35 and the pulley 65. This reduces or minimizes the slip of the belt 35 on the pulley 65.

[0055] Furthermore, the teeth 75 provided on the belt 35 meshes with the grooves 56 of the pulley 55, and the teeth 76 provided on the belt 35 meshes with the grooves 66 of the pulley 65. This prevents the slip of the belt 35 on the pulleys 55 and 65, and therefore the power of the driving unit 34 is stably transmitted to the twister belts 53 and 63. Due to this, there is less variation in the number of twists of each yarn Y1, Y2 per unit length. This reduces the possibility that the yarns Y have poor quality. In addition, the above arrangement reduces variation in yarn quality among the false-twisting devices 15.

[0056] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals and the explanations thereof are not repeated.

(1) While in the above-described embodiment, the teeth 75 and 76 are respectively provided on the inner and outer surfaces of the belt 35, and grooves 56, 66, 68, and 73 are respectively provided on the outer circumferential surfaces of the pulleys 55, 65, 67, and 72, this configuration is not essential. That is, the configuration shown in FIG. 6 is also possible: in each false-twisting device 81, no groove may be provided on the circumferential surfaces of a pulley 55a of a belt unit 32a, a pulley 65a of a belt unit 33a, a pulley 67a as the auxiliary pulley, and a pulley 72a of a driving unit 34a. In this modification, a belt 35a having no tooth such as a flat belt may be wrapped about the pulleys 55a, 65a, 67a, and 72a.

(2) While in the above-described embodiment, the pulley 67 is provided so as to be opposed to the pulley 55 with the pulley 65 interposed between them, this configuration is not essential. For example, the configuration shown in FIG. 7 is also possible: in each false-twisting device 82, the driving unit 34 may be provided so as to be opposed to the pulley 55 in the base longitudinal direction with the pulley 65 interposed between the driving unit 34 and the pulley 55. This allows the pulleys 55 and 65 to rotate in opposite directions to each other without providing the pulley 67.

(3) While in the above-described embodiment, the power of the motor 71 is transmitted to the belt units 32 and 33 via the pulleys and the belt, this configuration is not essential. For example, the power of the motor 71 may be transmitted to the belt units 32 and 33 via a gear or the like so that the twister belt 53 and the twister belt 63 rotate in the opposite directions to each other.

(4) While in the above-described embodiment, the shaft 41 extends in the base longitudinal direction so as to be shared among the plurality of false-twisting devices 15, each false-twisting device 15 may have its own shaft 41 and the shaft 41 may be connected to an unillustrated motor provided exclusively to the false-twisting device 15.

(5) While in the above-described embodiment, the motor 71 is provided between the disc 31 and the pulley 72, this is not essential. The motor 71 may be provided so as to be opposed to the disc 31 with the pulley 72 interposed between them, and the rotation shaft of the motor 71 may extend obliquely downward. This allows the motor 71 to be provided irrespectively of the size of the space between the disc 31 and the pulley 72, when the motor 71 has a large size.

(6) While in the above-described embodiment, each first heating device 13 of the draw texturing machine 1 is inclined with respect to the base width direction so that its downstream end in the yarn running direction is lower than its upstream end in the yarn running direction, this orientation is not essential. The false-twisting devices 15 may be applied for various types of draw texturing machines, for example, in which the first heating device is oriented substantially in parallel to the base width direction (see, for example, Japanese Unexamined Patent Publication No. 2016-223034).

Claims

1. A draw texturing machine comprising a plurality of false-twisting devices each configured to twist first and second different yarns in opposite directions to each other, each of the false-twisting devices com-

prising:

a disc configured to rotate;
a first belt unit provided close to a first surface of the disc and including a first twister belt configured to allow the first yarn to be interposed between the disc and the first twister belt;
a second belt unit provided close to a second surface of the disc and including a second twister belt configured to allow the second yarn to be interposed between the disc and the second twister belt; and
a common belt driving source configured to drive the first twister belt and the second twister belt.

2. The draw texturing machine according to claim 1, wherein:

the first belt unit includes a first driving pulley, a first driven pulley, and a first connection pulley, a first twister belt being wrapped around the first driving pulley and the first driven pulley, the first connection pulley being connected to the first driving pulley;
the second belt unit includes a second driving pulley, a second driven pulley, and a second connection pulley, a second twister belt being wrapped around the second driving pulley and the second driven pulley, the second connection pulley being connected to the second driving pulley;
a power transmission belt configured to be driven by the belt driving source is wrapped about the first connection pulley and the second connection pulley; and
an inner surface of the power transmission belt is in contact with the first connection pulley, and an outer surface of the power transmission belt is in contact with the second connection pulley.

3. The draw texturing machine according to claim 2, wherein:

an auxiliary pulley is provided so as to be opposed to the first connection pulley with the second connection pulley interposed between the auxiliary pulley and the first connection pulley;
the power transmission belt is wrapped about the first connection pulley, the second connection pulley, and the auxiliary pulley; and
the auxiliary pulley is in contact with the inner surface of the power transmission belt.

4. The draw texturing machine according to claim 2 or 3, wherein:

first teeth arranged in a belt longitudinal direction are provided on the inner surface of the power transmission belt;
second teeth arranged in the belt longitudinal direction are provided on the outer surface of the power transmission belt;
the first connection pulley has, on its outer circumferential surface, first grooves configured to mesh with the first teeth provided on the inner surface of the power transmission belt; and
the second connection pulley has, on its outer circumferential surface, second grooves configured to mesh with the second teeth provided on the outer surface of the power transmission belt.

FIG.1

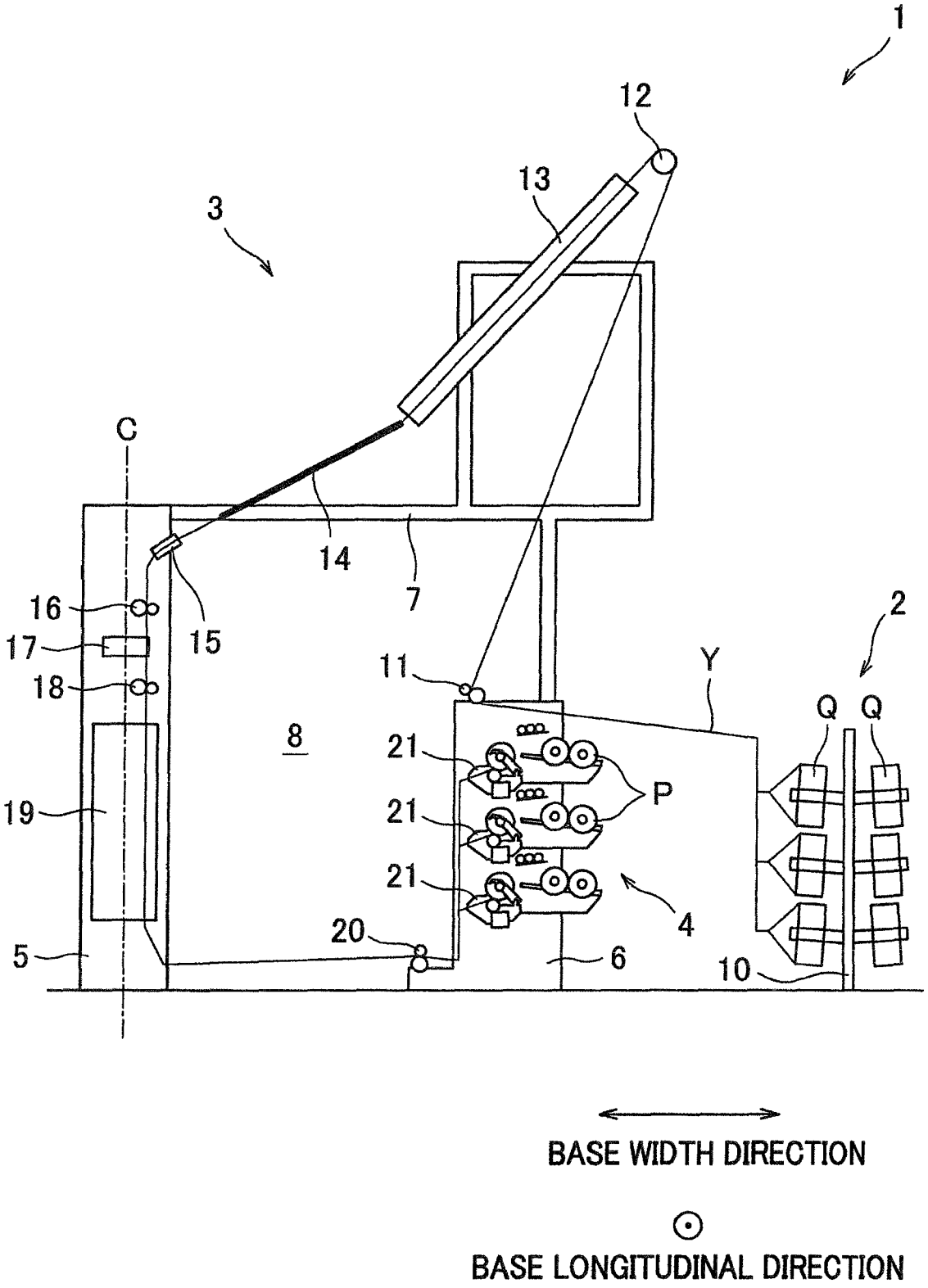
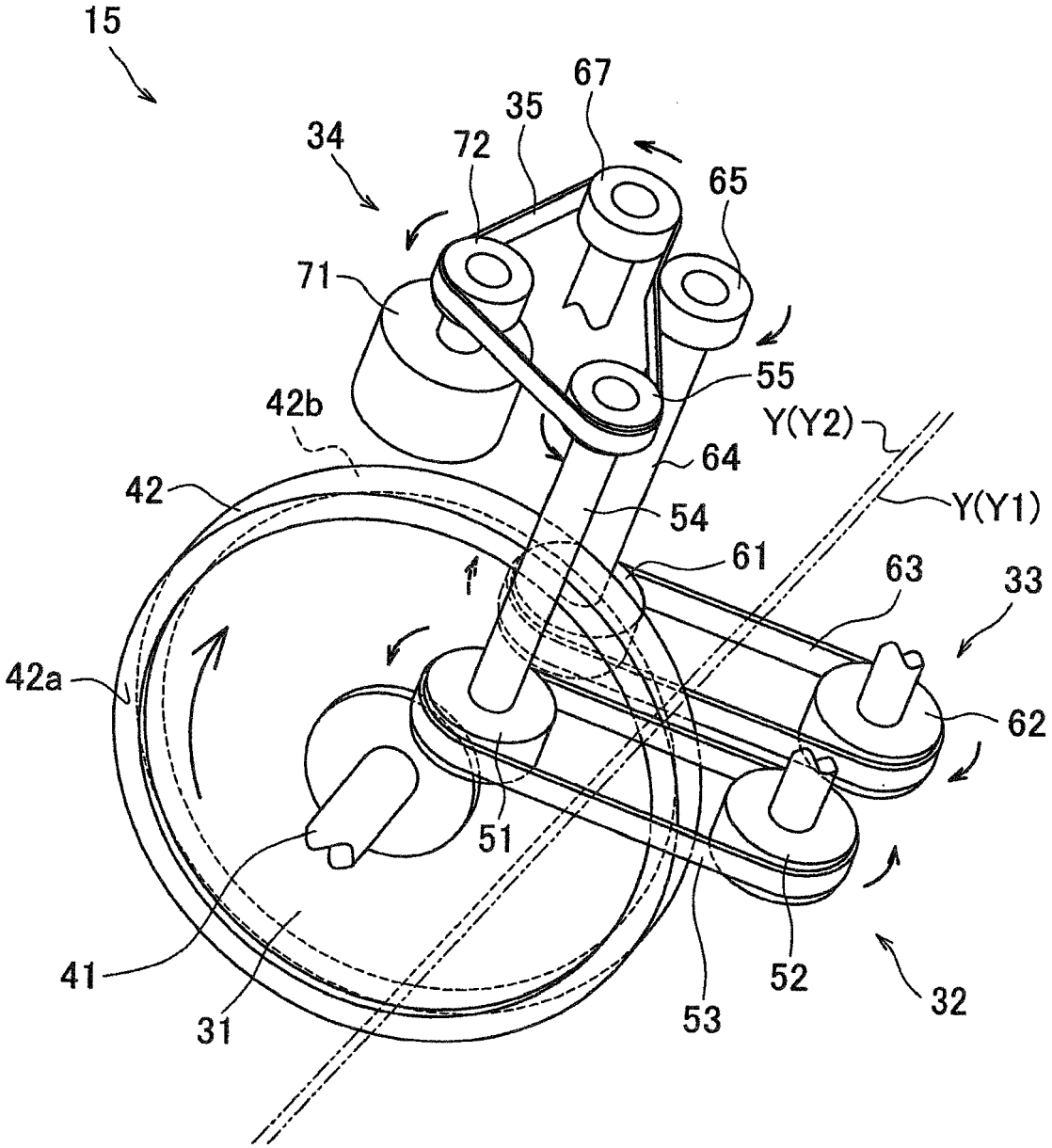

1
12
13
3
C
14
7
16
15
17
18
11
Y
2
Q
Q
8
21
P
21
19
21
4
20
5
6
10
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.2


15
67
35
34
72
65
71
55
42b
Y(Y2)
64
42
54
Y(Y1)
61
63
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42a
62
51
41
52
31
53
32

FIG.3

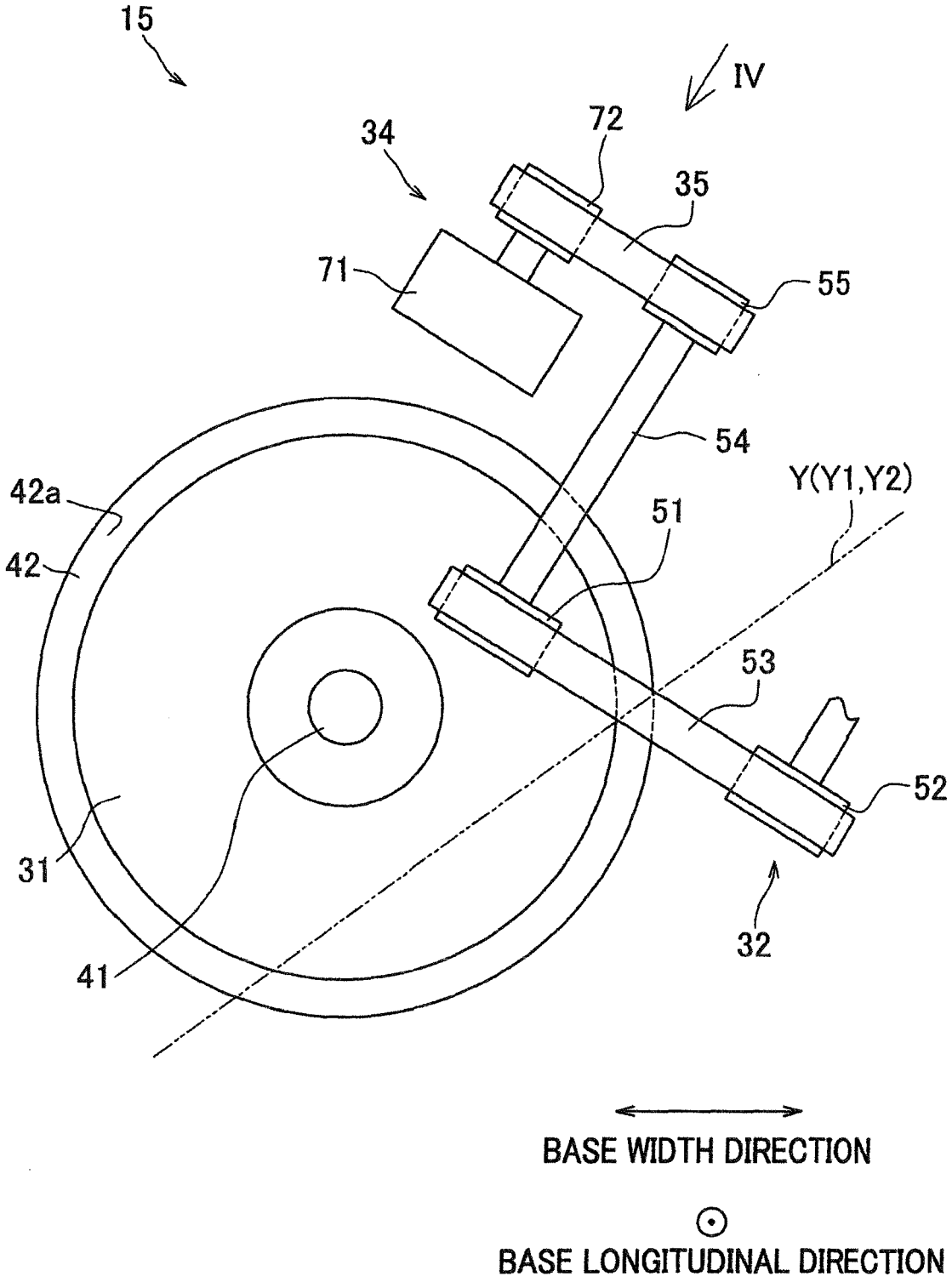
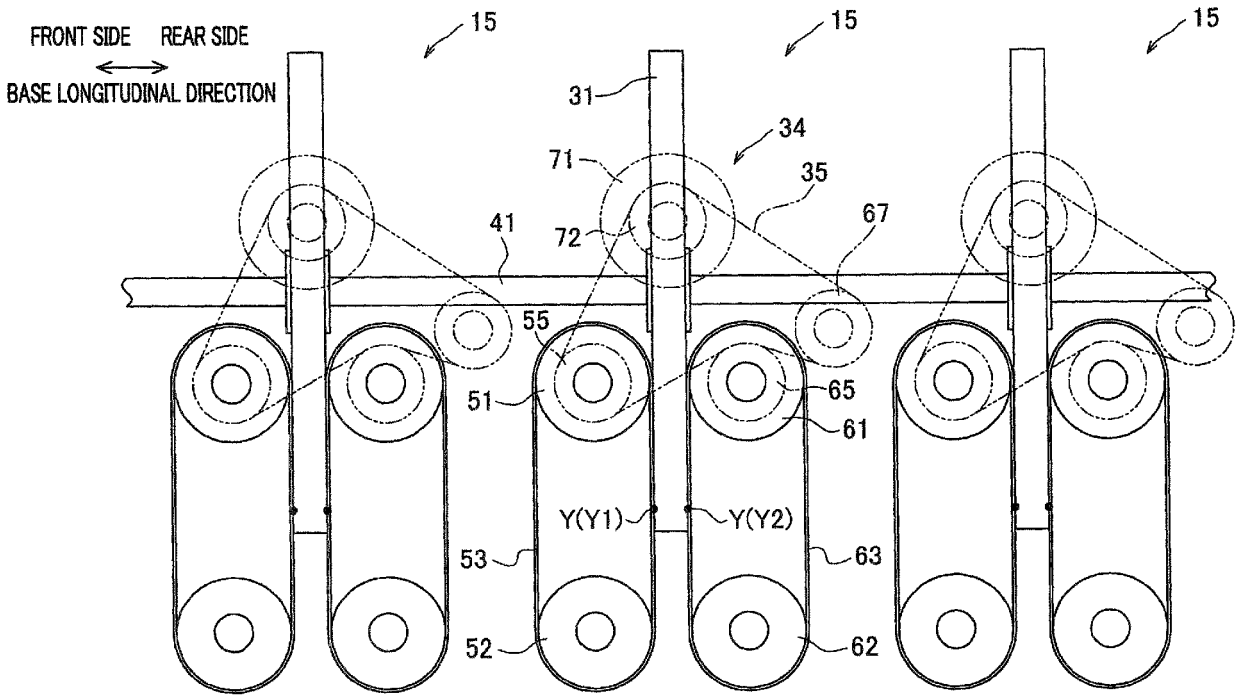

15
IV
34
72
35
71
55
54
Y(Y1,Y2)
42a
51
42
53
52
31
32
41
BASE WIDTH DIRECTION
BASE LONGITUDINAL DIRECTION

FIG.4


FRONT SIDE
REAR SIDE
BASE LONGITUDINAL DIRECTION
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15
15
31
34
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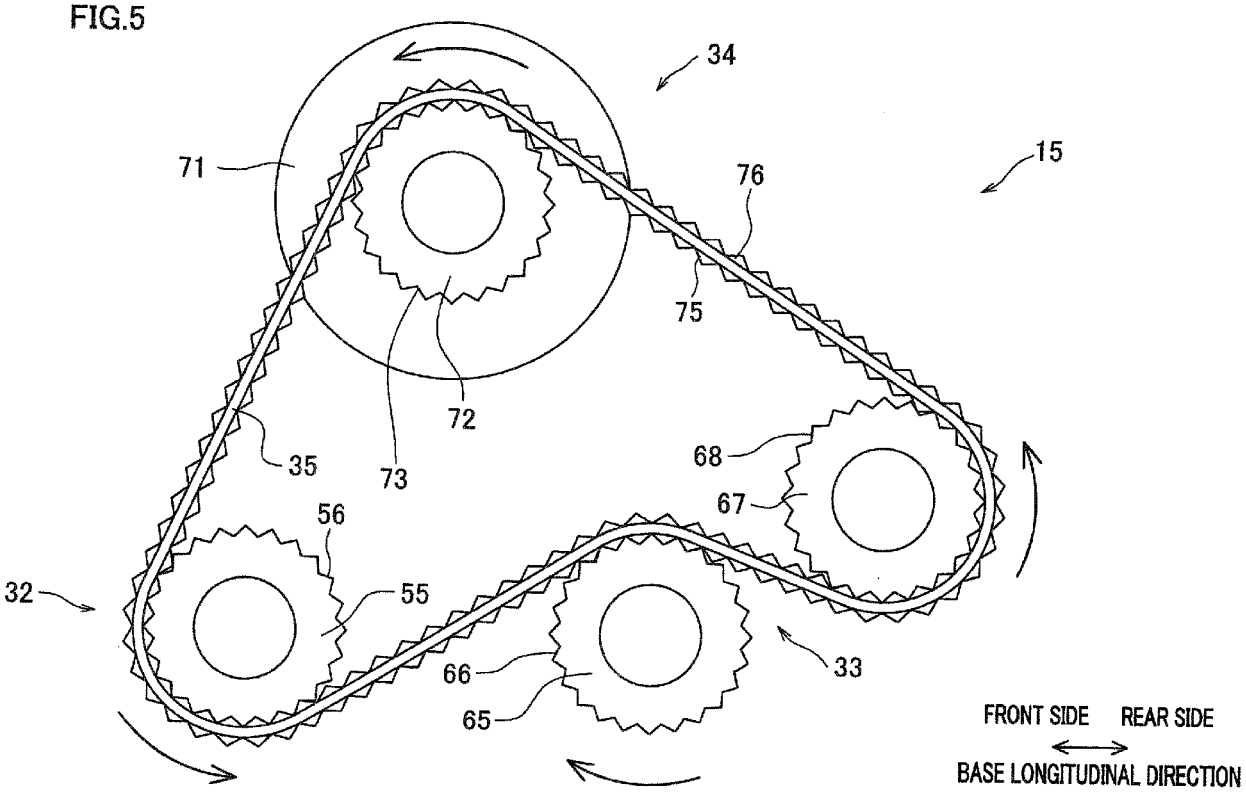
72
67
55
51
65
61
Y(Y1)
Y(Y2)
53
63
52
62

FIG.5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FRONT SIDE
REAR SIDE
BASE LONGITUDINAL DIRECTION

FIG.6

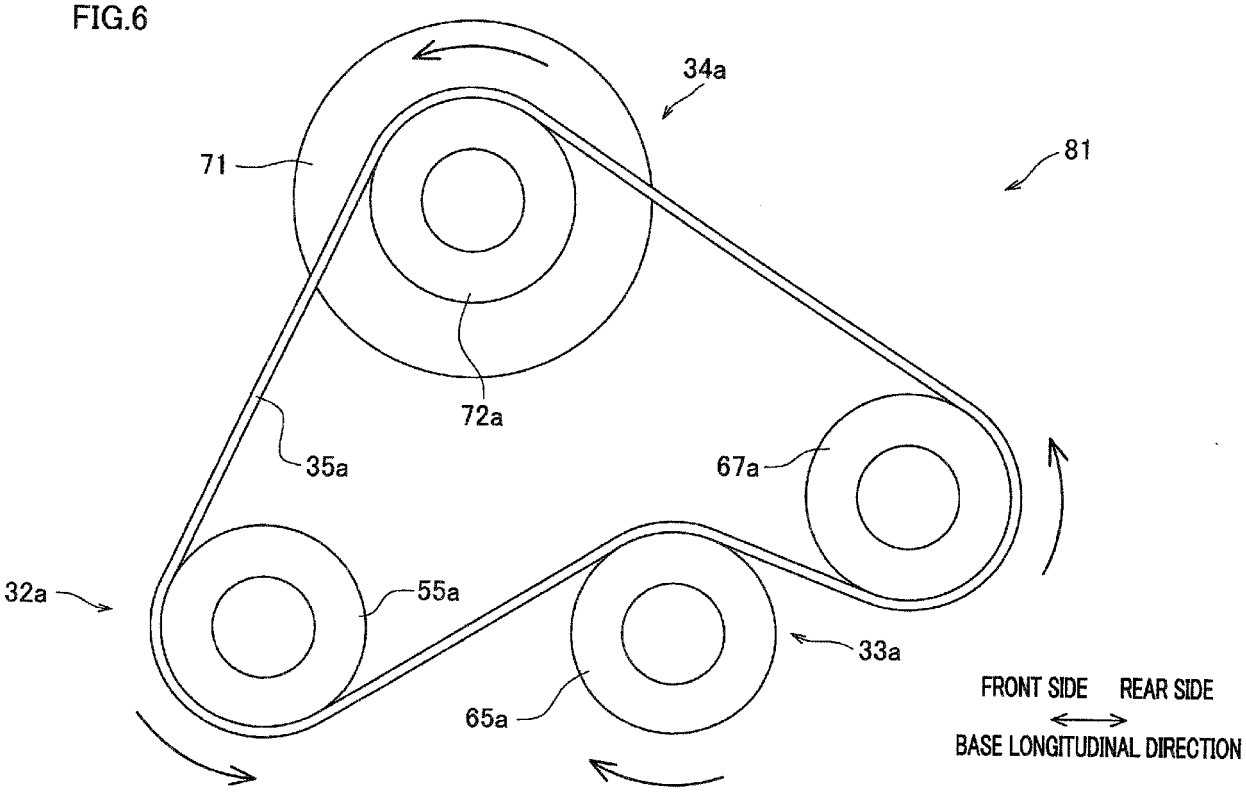
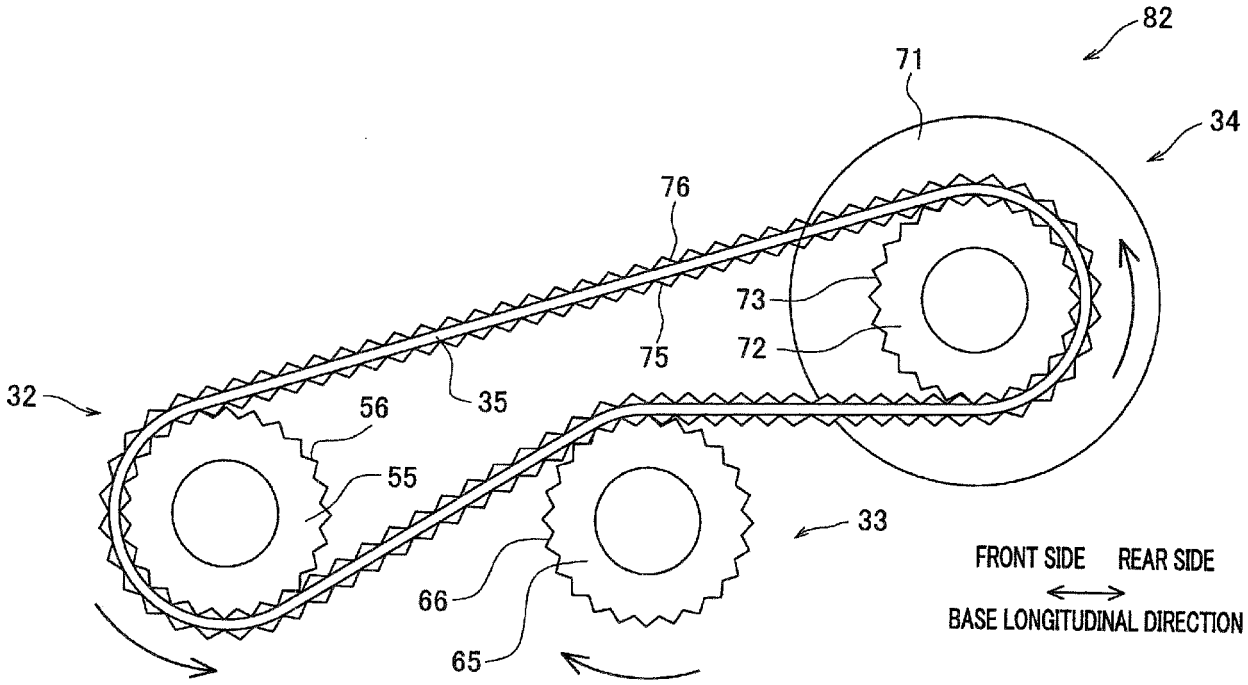

34a
71
81
72a
35a
67a
32a
55a
33a
65a
FRONT SIDE
REAR SIDE
BASE LONGITUDINAL DIRECTION

FIG.7


82
71
34
76
73
72
75
32
56
35
55
33
66
65
FRONT SIDE
REAR SIDE
BASE LONGITUDINAL DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 5074

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 May 2018	Van Beurden-Hopkins

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23-05-2018

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