(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 411 035 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.08.2024 Bulletin 2024/32

(21) Application number: **23220477.6**

(22) Date of filing: **28.12.2023**

(51) International Patent Classification (IPC):
D01D 5/096 (2006.01) ***D01D 5/088*** (2006.01)
D01D 5/092 (2006.01) ***D01D 13/02*** (2006.01)

(52) Cooperative Patent Classification (CPC):
D01D 5/096; D01D 5/088; D01D 5/092; D01D 13/02

(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

(30) Priority: **26.01.2023 JP 2023010416**

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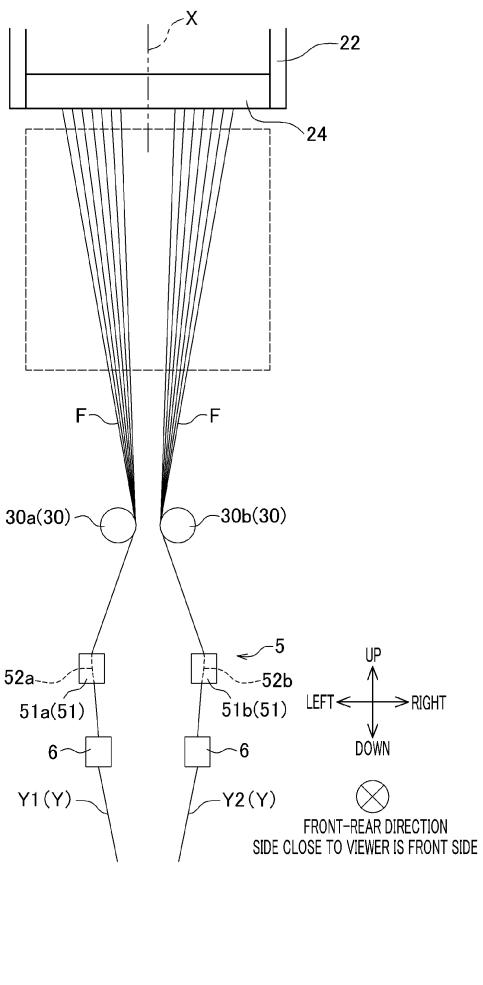
(54) **YARN PRODUCTION SYSTEM**

(57) An object of the present invention is to properly cool filaments in a structure in which the filaments are spun out downward from a single spinneret, divided into two groups, and bundled as two yarns.

A yarn production system 1 includes (i) a spinning apparatus 2 including a spinneret 24 provided with discharge ports 26, (ii) a cooler 4 provided below the spinneret 24, and (iii) an oiling unit 5 provided below the cooler 4. A virtual partitioning plane X divides the discharge ports 26 into a first discharge port group 26A and a second discharge port group 26B. The oiling unit 5 includes a first oil supply guide 51a including a first oil supply surface 52a and a second oil supply guide 51b including a second oil supply surface 52b. The yarn production system 1 further includes a first bundling guide 30a and a second bundling guide 30b which are provided below the cooler 4 and above the oiling unit 5. The distance between the first bundling guide 30a and the second bundling guide 30b is shorter than (i) the distance between the first oil supply guide 51a and second oil supply guide 51b of the oiling unit 5 and (ii) the distance between the barycentric position of the first discharge port group 26A and the barycentric position of the second discharge port group 26B.

FIG.4



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn production system structured so that filaments are spun out downward from a single spinneret, divided into two groups, and bundled as two yarns.

[0002] A known yarn production system includes (i) a spinning apparatus configured to spin out yarns downward from spinnerets provided at a lower end portion of the spinning apparatus and (ii) an oiling unit configured to apply oil to the yarns spun out from the spinning apparatus. Each spinneret is provided with discharge ports through which filaments are spun out. The filaments spun out through the discharge ports are bundled as yarns.

[0003] For example, Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2010-196219) discloses that filaments are spun out downward from a single spinneret, divided into plural (e.g., two) groups, and bundled as plural (e.g., two) yarns in order to improve the production efficiency. A cooler is provided below the spinneret, and an oiling unit (an oiling nozzle unit of Patent Literature 1) is provided below the cooler in order to apply oil to the yarns. The cooler is structured so that the filaments spun out from the spinneret are blown by cooling wind from their surroundings. The oiling unit includes oil supply guides to which the respective groups of filaments spun out from the spinneret are threaded. In this regard, filaments spun out downward from the spinneret are simultaneously cooled by means of the cooling wind from the cooler. The filaments are then divided into groups each of which forms a yarn and to which oil is applied by the respective oil supply guides. That is, the filaments spun out from the spinneret are divided into filament groups each of which is formed of filaments forming a yarn, and then the filament groups run toward the respective oil supply guides.

SUMMARY OF THE INVENTION

[0004] The filament groups spun out from the spinneret respectively run toward different oil supply guides. In this case, a space is formed between the filament groups running from the spinneret to the respective oil supply guides. As the cooling wind enters the space from the cooler, the disturbance of airflows occurs in the space. This disturbs the cooling wind blowing the filaments, and thus each filament is easily cooled at some parts and improperly cooled at other parts in a circumferential direction of the filament. Because of this, the filaments are unevenly cooled by means of the cooling wind. As a result, the quality of yarns formed of the filaments is deteriorated.

[0005] An object of the present invention is to properly cool filaments in a structure in which the filaments are spun out downward from a single spinneret, divided into two groups, and bundled as two yarns.

[0006] A yarn production system of the present invention comprises: a spinning apparatus including a spinneret provided with discharge ports through which filaments are spun out downward; a cooler which is provided below the spinneret and which is configured to cool the filaments by means of cooling wind; and an oiling unit which is provided below the cooler and which is configured to apply oil to a first yarn and a second yarn. In this regard, the filaments are divided into two groups and bundled as the first yarn and the second yarn, the discharge ports are divided into a first discharge port group through which filaments forming the first yarn are spun out and a second discharge port group through which filaments forming the second yarn are spun out, by a virtual partitioning plane extending in a vertical direction and a predetermined width direction intersecting with the vertical direction. The oiling unit includes: a first oil supply guide including a first oil supply surface with which a running first filament group formed of the filaments forming the first yarn makes contact and a pair of first yarn guiding members provided on both sides of the first oil supply surface in a horizontal direction to guide the first filament group toward the first oil supply surface; and a second oil supply guide including a second oil supply surface with which a running second filament group formed of the filaments forming the second yarn makes contact and a pair of second yarn guiding members provided on both sides of the second oil supply surface in the horizontal direction to guide the second filament group toward the second oil supply surface. The yarn production system further comprises: a first bundling guide which is provided below the cooler and above the oiling unit and to which the first filament group is threaded; and a second bundling guide which is provided below the cooler and above the oiling unit and to which the second filament group is threaded. In this regard, the distance between the first bundling guide and the second bundling guide in the horizontal direction is shorter than (i) the distance between the first oil supply guide and the second oil supply guide and (ii) the distance between the barycentric position of the first discharge port group and the barycentric position of the second discharge port group in the horizontal direction, the first oil supply guide is provided on the same side as the first discharge port group with respect to the virtual partitioning plane when viewed in the vertical direction, the second oil supply guide is provided on the same side as the second discharge port group with respect to the virtual partitioning plane when viewed in the vertical direction, the first oil supply surface extends in an up-down direction and a predetermined first width direction which is the horizontal direction, the second oil supply surface extends in the up-down direction and a predetermined second width direction which is the horizontal direction, when an angle between the first width direction and the virtual partitioning plane viewed in the vertical direction is 0 degree in a case where (i) the first width direction is in parallel to the virtual partitioning plane and (ii) the first oil supply surface is oriented in a direction opposite to a direction in which the first oil supply surface faces the virtual partitioning plane, the angle between the first width direction and the virtual partitioning plane viewed in the vertical direction is within the range of 90 to -90 degrees, when an angle between the second width direction and the virtual partitioning plane viewed in the vertical direction is 0 degree in a case where (i) the second width direction is in parallel to the virtual partitioning plane and (ii) the second oil supply surface is oriented in a direction opposite to a direction in which the second oil supply surface faces the virtual partitioning plane, and the angle between the second width direction and the virtual partitioning plane viewed in the vertical direction is within the range of 90 to -90 degrees. When the angle between the first width direction and the virtual partitioning plane is viewed in the vertical direction and 90 degrees, the first width direction is inclined from the virtual partitioning plane at 90 degrees clockwise. When the angle between the first width direction and the virtual partitioning plane is viewed in the vertical direction and -90 degrees, the first width direction is inclined from the virtual partitioning plane at 90 degrees counterclockwise. When the angle between the second width direction and the virtual partitioning plane is viewed in the vertical direction and 90 degrees, the second width direction is inclined from the virtual partitioning plane at 90 degrees clockwise. When the angle between the second width direction and the virtual partitioning plane is viewed in the vertical direction and -90 degrees, the second width direction is inclined from the virtual partitioning plane at 90 degrees counterclockwise.

[0007] In the present invention, the first filament group spun out from the spinneret is threaded to the first bundling guide provided above the oiling unit, and the second filament group spun out from the spinneret is threaded to the second bundling guide provided above the oiling unit. In this regard, the distance between the first bundling guide and the second bundling guide is shorter than (i) the distance between the first oil supply guide and the second oil supply guide and (ii) the distance between the barycentric position of the first discharge port group and the barycentric position of the second discharge port group. With this arrangement, the two filament groups running from the spinneret to the respective oil supply guides are threaded to the respective bundling guides provided above the oiling unit so as to be temporally bundled. Therefore, a space formed between the two filament groups running from the spinneret to the respective oil supply guides, i.e., between the two filament groups passing an area where the cooling wind from the cooler blows is made small. This suppresses the disturbance of airflows caused by the inflow of the cooling wind from the cooler into the space, and thus each of the filaments is properly blown by the cooling wind. It is therefore possible to properly cool the filaments.

[0008] In the present invention, the first oil supply guide is provided on the same side as the first discharge port group with respect to the virtual partitioning plane, and the second oil supply guide is provided on the same side as the second discharge port group with respect to the virtual partitioning plane. That is, the virtual partitioning plane is provided between the first oil supply guide and the second oil supply guide. In the present invention, each of (i) the angle between the first width direction and the virtual partitioning plane and (ii) the angle between the second width direction and the virtual partitioning plane is within the range of 90 to -90 degrees. That is, the first oil supply surface does not face the virtual partitioning plane. The same applies to the second oil supply surface. With these arrangements, when the first filament group is threaded to the first oil supply surface, yarn threading of the first filament group does not need to be performed from the virtual partitioning plane provided between the first oil supply guide and the second oil supply guide. As a result, the second oil supply guide does not disturb the yarn threading. The same applies to the case where the second filament group is threaded to the second oil supply surface. Therefore, the filament groups are easily threaded to the respective oil supply surfaces.

[0009] In the yarn production system of the present invention, preferably, the first discharge port group is arranged so that (i) discharge ports belonging to the first discharge port group form at least one first line extending in the predetermined width direction and at least one second line extending in a direction intersecting with the predetermined width direction, (ii) one of the at least one first line has more discharge ports than the at least one first line, (iii) one of the at least one second line has more discharge ports than the at least one second line, and (iv) the one of the at least one first line is larger than the one of the at least one second line in terms of the number of the discharge ports, and the second discharge port group is arranged so that (i) discharge ports belonging to the second discharge port group form at least one first line extending in the predetermined width direction and at least one second line extending in the direction intersecting with the predetermined width direction, (ii) one of the at least one first line has more discharge ports than the at least one first line, (iii) one of the at least one second line has more discharge ports than the at least one second line, and (iv) the one of the at least one first line is larger than the one of the at least one second line in terms of the number of the discharge ports. In this regard, when viewed in the vertical direction, each of the angle between the first width direction and the virtual partitioning plane and the angle between the second width direction and the virtual partitioning plane is within the range of 45 to -45 degrees.

[0010] In the present invention, each of the first discharge port group and the second discharge port group is arranged so that (i) discharge ports belonging to the first discharge port group form at least one first line extending in the predetermined width direction and at least one second line extending in the direction intersecting with the predetermined width direction, (ii) one of the at least one first line has more discharge ports than the at least one first line, (iii) one of the at least one second line has more discharge ports than the at least one second line, and (iv) the one of the at least one first line is larger than the one of the at least one second line in terms of the number of the discharge ports. When viewed in the vertical direction, the filaments spun out from the first discharge port group and the second discharge port group run downward toward the oiling unit while being aligned in the predetermined width direction in which the virtual partitioning plane extends. In this regard, the filaments are most widely dispersed in the predetermined width direction. When viewed in the vertical direction, each of (i) the angle between the first width direction and the virtual partitioning plane and (ii) the angle between the second width direction and the virtual partitioning plane is within the range of 45 to -45 degrees. Because of this, when viewed in the vertical direction, an angle between a direction in which the filaments spun out from the first discharge port group are most widely dispersed (i.e., the predetermined width direction) and the first width direction of the first oil supply surface is arranged to be as small as possible. Similarly, an angle between a direction in which the filaments spun out from the second discharge port group are most widely dispersed (i.e., the predetermined width direction) and the second width direction of the second oil supply surface is arranged to be as small as possible. As a result, the filaments spun out from each of the discharge port groups make contact with a corresponding oil supply surface while the filaments are dispersed as widely as possible. This reduces an overlap between adjacent filaments, and thus the number of filaments which directly make contact with the oil supply surfaces is arranged to be as many as possible. It is therefore possible to efficiently apply oil to the filaments.

[0011] In the yarn production system of the present invention, preferably, when viewed in the vertical direction, the first discharge port group and the second discharge port group are line-symmetric about the virtual partitioning plane, the first bundling guide and the second bundling guide are line-symmetric about the virtual partitioning plane, and the first oil supply surface and the second oil supply surface are line-symmetric about the virtual partitioning plane.

[0012] The filaments spun out from the two discharge port groups of the spinneret are cooled by means of the cooling wind supplied from the cooler provided between the spinning apparatus and the oiling unit. In the present invention, the following paths are plane-symmetric about the virtual partitioning plane: a path of the first filament group, which is spun out from the first discharge port group, to the first oil supply surface via the first bundling guide; and a path of the second filament group, which is spun out from the second discharge port group, to the second oil supply surface via the second bundling guide. With this arrangement, the filaments spun out from the first discharge port group are identical with the filaments spun out from the second discharge port group in regard to the length of a path on which the filaments are blown by the cooling wind from the cooler provided between the spinning apparatus and the oiling unit. It is therefore possible to equalize the quality of the two yarns formed of the filaments spun out from the two discharge port groups of the spinneret.

[0013] In the yarn production system of the present invention, preferably, a take-up roller for taking up the first yarn and the second yarn is provided downstream of the oiling unit in a yarn running direction in which the first yarn and the second yarn run, the first bundling guide and the second bundling guide are movable between regulation positions and yarn threading positions, the first bundling guide is moved to one of the regulation positions when the first yarn is taken up by the take-up roller and to one of the yarn threading positions when the first filament group is threaded to the first bundling guide, the second bundling guide is moved to the other of the regulation positions when the second yarn is taken up by the take-up roller and to the other of the yarn threading positions when the second filament group is threaded to the second bundling guide, and the distance between the first bundling guide at the one of the yarn threading positions and the second bundling guide at the other of the yarn threading positions is longer than the distance between the first bundling guide at the one of the regulation positions and the second bundling guide at the other of the regulation positions.

[0014] The distance between the first bundling guide and the second bundling guide at the respective yarn threading positions is longer than the distance between the first bundling guide and the second bundling guide at the respective regulation positions. With this arrangement, the filament groups are easily threaded to the respective bundling guides by moving the bundling guides to the yarn threading positions.

[0015] In the yarn production system of the present invention, preferably, the first bundling guide and the second bundling guide are bar guides.

[0016] In the present invention, the filament groups are easily threaded to the respective bundling guides by simply placing the filament groups along the bundling guides which are bar guides.

[0017] In the yarn production system of the present invention, preferably, each of the bar guides is rotatable about the axial center of the each of the bar guides, and the axial center of the each of the bar guides extends in an extending direction of the each of the bar guides.

[0018] In the present invention, a friction force on the filaments in contact with each of the bundling guides is decreased by rotating the bundling guides which are the bar guides in accordance with the running of the filament groups threaded to the respective bundling guides. This suppresses the decrease in quality of the yarns formed of the respective filament groups.

[0019] In the yarn production system of the present invention, preferably, the distance between the first bundling guide and the second bundling guide is equal to or more than 1 mm and equal to or less than 10 mm.

[0020] When the distance between the first bundling guide and the second bundling guide is too short, the filament groups threaded to the respective bundling guides may be tangled with one another. Meanwhile, when the distance between the first bundling guide and the second bundling guide is too long, the two filament groups cannot be bundled between the spinneret and the respective oil supply guides. This puts a limit on the decrease in size of a space formed between the two filament groups running between the spinneret and the respective oil supply guides. The present invention makes it possible to solve the above-described problem, to suppress the tangle of the filament groups threaded to the respective bundling guides, and to further decrease the size of a space formed between the two filament groups running between the spinneret and the respective oil supply guides.

[0021] In the yarn production system of the present invention, preferably, the cooler is an annular cooler in which the entire circumference of each of the running filaments is blown by the cooling wind.

[0022] When the entire circumference of the each of the filaments is blown by the cooling wind from the annular cooler, a lot of the cooling wind easily enters a space formed between the filament groups running between the spinneret and the oil supply guides. Furthermore, the disturbance of airflows easily occurs in the space. In the present invention, the annular cooler makes it possible to effectively suppress the disturbance of airflows caused by the inflow of the cooling wind from the cooler into the space. It is therefore possible to further properly cool the filaments.

[0023] In the spun yarn production system of the present invention, preferably, the first bundling guide and the second bundling guide are closer to the cooler than to the oiling unit in the vertical direction.

[0024] In the present invention, the two filament groups running between the spinneret and the respective oil supply guides are temporarily bundled at a position closer to the cooler than to the respective oil supply guides in the vertical direction. This further decreases the size of a space formed between the two filament groups running from the spinneret to the respective bundling guides, i.e., between the two filament groups passing the cooler.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a profile of a yarn production system of an embodiment.

FIG. 2 is a partial cross section of a spinning apparatus and a cooler in the present embodiment.

FIG. 3 is a bottom view of a spinneret of the present embodiment.

FIG. 4 shows the spinneret and bundling guides and one oiling unit which are provided below the spinneret.

FIG. 5 is a perspective view of the bundling guides of the present embodiment.

FIG. 6 is a top view of oil supply guides of the present embodiment.

FIG. 7 shows the bundling guides at yarn threading positions.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Overall Structure of Yarn Production System 1)

[0026] The following will describe a preferred embodiment of the present invention with reference to figures. FIG. 1 is a profile of a yarn production system 1 of the present embodiment. FIG. 2 is a partial cross section of a spinning apparatus 2 and a cooler 4. FIG. 3 is a bottom view of one spinneret 24. FIG. 4 shows one of spinnerets 24 and an oiling unit 5 provided below the one of spinnerets 24. FIG. 5 is a perspective view of bundling guides 30. FIG. 6 is a top view of oil supply guides 51. FIG. 1 and FIG. 2 do not show the bundling guides 30. Hereinafter, front-rear, left-right, and up-down directions in FIG. 1 will be referred to as front-rear, left-right, and up-down directions of the yarn production system 1. The up-down direction is a vertical direction of the present invention, and is a direction in which the gravity acts.

[0027] As shown in FIG. 1, the yarn production system 1 includes the spinning apparatus 2 and a spun yarn take-up apparatus 3. The spinning apparatus 2 is configured to spin out molten polymer downward as yarns Y. The spun yarn take-up apparatus 3 is configured to take up the yarns Y spun out from the spinning apparatus 2 and includes the cooler 4, oiling units 5, yarn path regulatory guides 6, a comb teeth guide 7, godet rollers 8 and 9, and a spun yarn take-up winding apparatus 10.

[0028] As shown in FIG. 2, the spinning apparatus 2 includes a spinning beam 21, spinning packs 22 attached to a housing formed at a lower portion of the spinning beam 21, and a polymer tank 23 housing polymer which is a material of the yarns Y. The spinning beam 21 is able to heat, e.g., (i) the spinning packs 22 provided therein, (ii) the polymer tank 23, and (iii) polymer pipes 25 connecting the spinning packs 22 to the polymer tank 23. For example, the spinning beam 21 is rectangular in plan view and long in the left-right direction. The spinning packs 22 are staggered to form two lines with respect to the spinning beam 21 which is rectangular in plan view. In other words, the spinning packs 22 are provided to form two lines in the front-rear direction of the rectangular spinning beam 21 and, in the left-right direction, the positions of spinning packs 22 forming the front line are different from those of spinning packs 22 forming the rear line.

[0029] Each spinning pack 22 stores molten polymer therein and has a spinneret 24 at its lower end portion. In the present embodiment, each spinneret 24 is configured to spin out (see FIG. 4) filaments F forming two yarns Y (hereinafter, these yarns Y may be referred to as a first yarn Y1 and a second yarn Y2). As shown in FIG. 3, the spinneret 24 is substantially circular in shape when viewed from below. The diameter of the spinneret 24 is, e.g., 85 mm. Throughout the spinneret 24, discharge ports 26 are provided in order to spin out the filaments F downward. To be more specific, the discharge ports 26 are aligned in the front-rear direction and the left-right direction. For example, each spinneret 24 is provided with 144 discharge ports 26. The molten polymer stored in each spinning pack 22 is spun out, as the filaments F, downward from the discharge ports 26 provided at the spinneret 24.

[0030] As shown in FIG. 3, the discharge ports 26 are divided into a first discharge port group 26A provided for spinning out filaments F forming the first yarn Y1 (see FIG. 4) and a second discharge port group 26B provided for spinning out filaments F forming the second yarn Y2 (see FIG. 4). To be more specific, a virtual partitioning plane X extending in the front-rear direction (a predetermined width direction of the present invention) and the up-down direction divides the discharge ports 26 into the first discharge port group 26A and the second discharge port group 26B (see FIG. 3 and FIG. 4). As shown in FIG. 3, when viewed in the up-down direction, the first discharge port group 26A and the second discharge port group 26B are line-symmetric about the virtual partitioning plane X. The first discharge port group 26A is formed of 72 discharge ports 26. As shown in FIG. 3, the first discharge port group 26A is arranged so that (i) discharge ports 26 belonging to the first discharge port group 26A form first lines extending along the front-rear direction and second lines extending in a direction (the left-rear direction, an oblique direction, or the like) intersecting with the front-rear direction, i.e., in a direction different from the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26. The second discharge port group 26B is formed of 72 discharge ports 26. As shown in FIG. 3, the second discharge port group 26B is arranged so that (i) discharge ports 26 belonging to the second discharge port group 26B form first lines extending along the front-rear direction and second lines extending in a direction (the left-rear direction, an oblique direction, or the like) intersecting with the front-rear direction, i.e., in a direction different from the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26. As shown in FIG. 4, the filaments F spun out from the first discharge port group 26A are bundled as the first yarn Y1. The filaments F spun out from the second discharge port group 26B are bundled as the second yarn Y2. That is, filaments F spun out from each spinneret 24 are divided into two groups and bundled as two yarns Y (the first yarn Y1 and the second yarn Y2).

[0031] The polymer tank 23 is configured to store polymer therein, and the polymer in the polymer tank 23 is sent to the spinning packs 22 through the polymer pipes 25. When the polymer is sent to the spinning packs 22 from the polymer tank 23, the polymer in the polymer tank 23 and the polymer pipes 25 is heated at a predetermined temperature by the spinning beam 21, with the result that molten polymer is made.

[0032] The cooler 4 is configured to cool the yarns Y spun out from the spinning packs 22 by means of cooling wind. To be more specific, the cooler 4 is configured to cool filaments F spun out from the spinnerets 24 formed at lower end portions of the spinning packs 22 by means of the cooling wind. The cooler 4 is an annular cooler in which the entire circumference of each running filament F is blown by the cooling wind. As shown in FIG. 2, the cooler 4 is provided below the spinning beam 21 and includes cooling cylinders 41 and a cooling wind supplying box 42 housing the cooling cylinders 41. The cooling cylinders 41 are provided immediately below the respective spinning packs 22. Each cooling cylinder 41 extends in the up-down direction, is hollow and substantially cylindrical in shape, is open at its both ends in the up-down direction, and is provided with a yarn running space 43 therein. A part of the cooling cylinder 41 defines a yarn running space 43, and adjusts the cooling wind flowing into the yarn running space 43 from an internal space 44 of the cooling wind supplying box 42. Each internal space 44 is provided across the entire circumferential direction of the yarn running space 43. The cooling wind is sent to each of internal spaces 44 of the cooling wind supplying box 42 from an unillustrated duct through an unillustrated cooling air pipe. In FIG. 2, the cooling air pipe is provided behind the cooler 4 in the direction orthogonal to the plane (i.e., the front-rear direction).

[0033] The oiling units 5 are configured to apply oil to yarns Y spun out downward from the spinning packs 22. To be more specific, each oiling unit 5 is configured to apply oil to filaments F which are divided into two groups and bundled as two yarns Y (the first yarn Y1 and the second yarn Y2). As shown in FIG. 2, the oiling units 5 are provided immediately below the cooling cylinders 41. That is, the oiling units 5 are provided to correspond to the respective spinning packs 22.

[0034] Each oiling unit 5 includes two oil supply guides 51 to which two filament groups are respectively threaded. The two filament groups are formed of the filaments F forming the two yarns Y (the first yarn Y1 and the second yarn Y2) spun out from a single spinneret 24. To be more specific, as the two oil supply guides 51, each oiling unit 5 includes (i) a first oil supply guide 51a to which filaments F (hereinafter, this will be referred to as a first filament group) spun out from the first discharge port group 26A are threaded and (ii) a second oil supply guide 51b to which filaments F (hereinafter, this will be referred to as a second filament group) spun out from the second discharge port group 26B are threaded. When viewed in the up-down direction, (i) the first oil supply guide 51a is provided on the same side as the first discharge port group 26A with respect to the virtual partitioning plane X and (ii) the second oil supply guide 51b is provided on the same side as the second discharge port group 26B with respect to the virtual partitioning plane X. To be more specific, the first oil supply guide 51a is provided substantially and immediately below a barycentric position of the first discharge port group 26A. Assume that (i) each discharge port 26 belonging to the first discharge port group 26A has its own weight and (ii) the discharge ports 26 of the first discharge port group 26A are equal to one another in weight. In this case, when viewed in the up-down direction, the barycentric position of the first discharge port group 26A is the barycentric position (centroid) of centers of the discharge ports 26 of the first discharge port group 26A. In this regard, a single barycentric position is set with respect to the centers of the discharge ports 26 of the first discharge port group 26A. The second oil supply guide 51b is provided substantially and immediately below a barycentric position of the second discharge port group 26B. Assume that (i) each discharge port 26 belonging to the second discharge port group 26B has its own weight and (ii) the discharge ports 26 of the second discharge port group 26B are equal to one another in weight. In this case, when viewed in the up-down direction, the barycentric position of the second discharge port group 26B is the barycentric position (centroid) of centers of the discharge ports 26 of the second discharge port group 26B. In this regard, a single barycentric position is set with respect to the centers of the discharge ports 26 of the second discharge port group 26B.

[0035] The first oil supply guide 51a includes (see FIG. 6) (i) a first oil supply surface 52a with which the running first filament group formed of filaments F forming the first yarn Y1 makes contact, (ii) a pair of first yarn guiding members 53a for guiding the first filament group to the first oil supply surface 52a, and (iii) an oil discharge hole (not illustrated) through which oil is discharged. As shown in FIG. 6, the first oil supply surface 52a extends in the up-down direction and a predetermined first width direction D1 which is a horizontal direction. When viewed in the up-down direction, an angle between the first width direction D1 and the virtual partitioning plane X is within the range of 90 to -90 degrees. Preferably, this angle is within the range of 45 to -45 degrees. When the angle between the first width direction D1 and the virtual partitioning plane X is viewed in the up-down direction and 90 degrees, the first width direction D1 is inclined from the virtual partitioning plane X at 90 degrees clockwise. When the angle between the first width direction D1 and the virtual partitioning plane X is viewed in the up-down direction and -90 degrees, the first width direction D1 is inclined from the virtual partitioning plane X at 90 degrees counterclockwise. The same applies to the case where this angle is 45 degrees and the case where this angle is -45 degrees. When the angle between the first width direction D1 and the virtual partitioning plane X is 0 degrees, (i) the first width direction D1 is in parallel to the virtual partitioning plane X and (ii) the first oil supply surface 52a is oriented in a direction opposite to a direction in which the first oil supply surface 52a faces the virtual partitioning plane X. In the present embodiment, when viewed in the up-down direction, the angle between the first width direction D1 and the virtual partitioning plane X is 0 degrees. In other words, in the present embodiment, both the first width direction D1 and the virtual partitioning plane X are in parallel to the front-rear direction. The following will detail the angle between the first width direction D1 and the virtual partitioning plane X. Assume that, when (i) the first width direction D1 is in parallel to the virtual partitioning plane X and (ii) the first oil supply surface 52a is oriented in the direction opposite to the direction in which the first oil supply surface 52a faces the virtual partitioning plane X (see FIG. 6), the angle between the first width direction D1 and the virtual partitioning plane X viewed in the up-down direction is 0 degree. With this premise, the "angle between the first width direction D1 and the virtual partitioning plane X" is an angle between the first width direction D1 and the virtual partitioning plane X viewed in the up-down direction. For example, when (i) the virtual partitioning plane X extends in the front-rear direction and (ii) the angle between the first width direction D1 and the virtual partitioning plane X is viewed in the up-down direction and -90 degrees, the first oil supply surface 52a is oriented to the front while the first width direction D1 is in parallel to the left-right direction. For example, when (i) the virtual partitioning plane X extends in the front-rear direction and (ii) the angle between the first width direction D1 and the virtual partitioning plane X is viewed in the up-down direction and 90 degrees, the first width direction D1 is in parallel to the left-right direction and the first oil supply surface 52a is oriented to the rear while the virtual partitioning plane X extends in the front-rear direction.

[0036] The first oil supply surface 52a is curved in the up-down direction (see FIG. 4). A dashed line of FIG. 6 shows a lower end of the first oil supply surface 52a which is curved in the up-down direction. The first oil supply surface 52a may not be curved but may extend in parallel to the up-down direction. The oil is discharged from the oil discharge hole, flows along the first oil supply surface 52a, and is applied to the filaments F forming the first yarn Y1 running while being in contact with the first oil supply surface 52a. The paired first yarn guiding members 53a are provided on both sides of the first oil supply surface 52a in the front-rear direction which is the horizontal direction. Each first yarn guiding member 53a extends leftward from the first oil supply surface 52a. The filaments F spun out from the first discharge port group 26A are oiled by the first oil supply guide 51a and then interlaced, etc. so as to form the first yarn Y1 which is a multi-filament yarn.

[0037] The second oil supply guide 51b includes (see

FIG. 6) (i) a second oil supply surface 52b with which the running second filament group formed of filaments F forming the second yarn Y2 makes contact, (ii) a pair of second yarn guiding members 53b for guiding the second filament group to the second oil supply surface 52b, and (iii) an oil discharge hole (not illustrated) through which oil is discharged. As shown in FIG. 6, the second oil supply surface 52b extends in the up-down direction and a predetermined second width direction D2 which is the horizontal direction. When viewed in the up-down direction, an angle between the second width direction D2 and the virtual partitioning plane X is within the range of 90 to -90 degrees. Preferably, this angle is within the range of 45 to -45 degrees. When the angle between the second width direction D2 and the virtual partitioning plane X is viewed in the up-down direction and 90 degrees, the second width direction D2 is inclined from the virtual partitioning plane X at 90 degrees clockwise. When the angle between the second width direction D2 and the virtual partitioning plane X is viewed in the up-down direction and -90 degrees, the second width direction D2 is inclined from the virtual partitioning plane X at 90 degrees counterclockwise. The same applies to the case where this angle is 45 degrees and the case where this angle is -45 degrees. When the angle between the second width direction D2 and the virtual partitioning plane X is 0 degree, (i) the second width direction D2 is in parallel to the virtual partitioning plane X and (ii) the second oil supply surface 52b is oriented in a direction opposite to a direction in which the second oil supply surface 52b faces the virtual partitioning plane X. In the present embodiment, when viewed in the up-down direction, the angle between the second width direction D2 and the virtual partitioning plane X is 0 degree. In other words, in the present embodiment, both the second width direction D2 and the virtual partitioning plane X are in parallel to the front-rear direction. The following will detail the angle between the second width direction D2 and the virtual partitioning plane X. Assume that, when (i) the second width direction D2 is in parallel to the virtual partitioning plane X and (ii) the second oil supply surface 52b is oriented in the direction opposite to the direction in which the second oil supply surface 52b faces the virtual partitioning plane X (see FIG. 6), the angle between the second width direction D2 and the virtual partitioning plane X viewed in the up-down direction is 0 degree. With this premise, the "angle between the second width direction D2 and the virtual partitioning plane X" is an angle between the second width direction D2 and the virtual partitioning plane X viewed in the up-down direction. For example, when (i) the virtual partitioning plane X extends in the front-rear direction and (ii) the angle between the second width direction D2 and the virtual partitioning plane X is viewed in the up-down direction and 90 degrees, the second oil supply surface 52b is oriented to the front while the second width direction D2 is in parallel to the left-right direction. For example, when (i) the virtual partitioning plane X extends in the front-rear direction and (ii) the angle between the second width direction D2 and the virtual partitioning plane X is viewed in the up-down direction and -90 degrees, the second width direction D2 is in parallel to the left-right direction and the second oil supply surface 52b is oriented to the rear while the virtual partitioning plane X extends in the front-rear direction.

[0038] The second oil supply surface 52b is curved in the up-down direction (see FIG. 4). A dashed line of FIG. 6 shows a lower end of the second oil supply surface 52b which is curved in the up-down direction. The second oil supply surface 52b may not be curved but may extend in parallel to the up-down direction. The oil is discharged from the oil discharge hole, flows along the second oil supply surface 52b, and is applied to the filaments F forming the second yarn Y2 running while being in contact with the second oil supply surface 52b. The paired second yarn guiding members 53b are provided on both sides of the second oil supply surface 52b in the front-rear direction which is the horizontal direction. Each second yarn guiding member 53b extends rightward from the second oil supply surface 52b. The filaments F spun out from the second discharge port group 26B are oiled by the second oil supply guide 51b and then interlaced, etc. so as to form the second yarn Y2 which is a multi-filament yarn.

[0039] In the present embodiment, the first oil supply surface 52a and the second oil supply surface 52b are provided back to back. That is, the first oil supply surface 52a is oriented to the left, and the second oil supply surface 52b is oriented to the right. As shown in FIG. 6, when viewed in the up-down direction, the first oil supply surface 52a and the second oil supply surface 52b are line-symmetric about the virtual partitioning plane X.

[0040] Each yarn path regulatory guide 6 is provided to regulate (define) a yarn path so that a yarn Y is properly pressed onto an oil supply surface of an oil supply guide 51. As shown in FIG. 2, two yarn path regulatory guides 6 are provided below each oiling unit 5. To be more specific, the two yarn path regulatory guides 6 are respectively provided below a first oil supply guide 51a and second oil supply guide 51b of the oiling unit 5. In this regard, a yarn path regulatory guide 6 provided below the first oil supply guide 51a regulates a yarn path so that the filaments F forming the first yarn Y1 are properly pressed onto the first oil supply surface 52a of the first oil supply guide 51a. A yarn path regulatory guide 6 provided below the second oil supply guide 51b regulates a yarn path so that the filaments F forming the second yarn Y2 are properly pressed onto the second oil supply surface 52b of the second oil supply guide 51b.

[0041] The comb teeth guide 7 is provided with grooves (not illustrated) which are formed at regular intervals in the left-right direction in order to guide yarns Y. Each groove of the comb teeth guide 7 is open at its both ends in the up-down direction and at its front or rear end. The comb teeth guide 7 is provided below an approximate center of the yarn path regulatory guides 6 in the left-right direction and the front-rear direction. The yarns Y are guided by the yarn path regulatory guides 6 and then by the grooves of the comb teeth guide 7, with the result that the yarns Y run downward while being aligned at regular intervals in the left-right direction.

[0042] Yarn threading to each oil supply guide 51, each yarn path regulatory guide 6, and the comb teeth guide 7 may be performed by an operator or may be automatically performed.

[0043] The godet rollers 8 and 9 are provided downstream of the comb teeth guide 7 in a yarn running direction as shown in FIG. 1, and are rotationally driven by unillustrated motors. The yarns Y spun out from the spinning apparatus 2 are wound onto the godet roller 8 and the godet roller 9 in this order after passing the yarn running spaces 43 of the cooler 4, the oiling units 5, the yarn path regulatory guides 6, and the comb teeth guide 7. The yarns Y are then sent to the spun yarn take-up winding apparatus 10 by the godet rollers 8 and 9. The godet rollers 8 and 9 are equivalent to a take-up roller of the present invention.

[0044] The spun yarn take-up winding apparatus 10 is configured to wind the yarns Y onto bobbins B retained by one bobbin holder 11, so as to form packages P. The spun yarn take-up winding apparatus 10 is provided with two bobbin holders 11. Each bobbin holder 11 is a shaft member extending in the front-rear direction, and is cantilevered at its rear end portion by a turret 13 provided on a frame 12. The bobbin holder 11 is able to retain the bobbins B which are aligned in its axial direction. For example, when eight yarns Y are sent from the spinning apparatus 2, the eight yarns Y are wound onto eight bobbins B.

[0045] The spun yarn take-up winding apparatus 10 includes a supporting frame 14 which extends in the front-rear direction and which is substantially in parallel to the bobbin holders 11. The supporting frame 14 is cantilevered at its rear end portion by the frame 12. At an upper part of the supporting frame 14, a guide supporter 15 is provided to extend in the front-rear direction. On the guide supporter 15, supporting guides 16 are aligned in the front-rear direction so as to correspond to the respective bobbins B retained by each bobbin holder 11. On the supporting frame 14, traverse devices 17 are aligned in the front-rear direction so as to correspond to the respective bobbins B retained by each bobbin holder 11. Each traverse device 17 is configured to traverse a yarn Y in the front-rear direction about a corresponding supporting guide 16.

[0046] The spun yarn take-up winding apparatus 10 further includes a contact roller 18 which is rotatably supported by the supporting frame 14. The contact roller 18 is provided below the supporting frame 14. Operations of the spun yarn take-up winding apparatus 10 are controlled by an unillustrated controller. The spun yarn take-up winding apparatus 10 is configured to start winding of the yarns Y, which are traversed by the traverse devices 17, onto new bobbins B attached to upper one of the two bobbin holders 11. While the yarns Y are wound, the contact roller 18 is suitably moved up or down and/or the turret 13 is suitably and rotationally driven. In this way, the packages P are formed in accordance with the increase in diameter of the packages P.

[0047] The two filament groups are spun out from each spinneret 24, and respectively run toward different oil supply guides 51. To be more specific, the first filament group formed of the filaments F spun out from the first discharge port group 26A of the spinneret 24 runs toward the first oil supply guide 51a, and the second filament group formed of the filaments F spun out from the second discharge port group 26B runs toward the second oil supply guide 51b. In this case, a space is formed between the two filament groups running from the spinneret 24 to the two oil supply guides 51. As the cooling wind enters the space from the cooler 4, the disturbance of airflows occurs in the space. This disturbs the cooling wind blowing the filaments F, and thus each filament F is easily cooled at some parts and improperly cooled at other parts in a circumferential direction of the filament F. Because of this, the filaments F are unevenly cooled by means of the cooling wind. As a result, the quality of the yarns Y formed of the filaments F is deteriorated. In the present embodiment, the bundling guides 30 are provided in order to properly cool the filaments F. The following will describe the bundling guides 30 of the present embodiment with reference to FIG. 4, FIG. 5, and FIG. 7.

(Bundling Guide 30)

[0048] As shown in FIG. 4, bundling guides 30 are provided below the cooler 4 and above an oiling unit 5. Each bundling guide 30 is closer to the cooler 4 than to the oiling unit 5 in the up-down direction. Two bundling guides 30 are provided above each oiling unit 5. To be more specific, the two bundling guides 30 are provided above the oiling unit 5 and includes (i) a first bundling guide 30a provided above the first oil supply guide 51a and (ii) a second bundling guide 30b provided above the second oil supply guide 51b. In this regard, the first filament group formed of the filaments F spun out from the first discharge port group 26A is threaded to the first bundling guide 30a. The second filament group formed of the filaments F spun out from the second discharge port group 26B is threaded to the second bundling guide 30b.

[0049] As shown in FIG. 5, each bundling guide 30 is a bar guide whose extending direction is the front-rear direction. To be more specific, each bundling guide 30 is a cylindrical bar guide extending in the front-rear direction. In this regard, the first filament group spun out from the first discharge port group 26A is placed on a right part of a circumferential surface of the first bundling guide 30a which is a bar guide. The second filament group spun out from the second discharge port group 26B is placed on a left part of a circumferential surface of the second bundling guide 30b which is a bar guide. Each bundling guide 30 which is a bar guide is rotatable (indicated by a solid arrow in FIG. 5) about the axial center of the circular bundling guide 30 extending in the front-rear direction. Each bundling guide 30 is, e.g., freely rotatable. Each bundling guide 30 which is a bar guide is made of, e.g., ceramic.

[0050] As shown in FIG. 4, the distance between the first bundling guide 30a and the second bundling guide 30b in the left-right direction (the horizontal direction) is shorter than the distance between the first oil supply guide 51a and second oil supply guide 51b of the oiling unit 5 in the left-right direction (the horizontal direction). Furthermore, the distance between the first bundling guide 30a and the second bundling guide 30b in the left-right direction (the horizontal direction) is shorter than the distance between the barycentric position of the first discharge port group 26A and that of the second discharge port group 26B in the left-right direction (the horizontal direction). When viewed in the front-rear direction, the distance between the first bundling guide 30a and the second bundling guide 30b is the distance between the center of an area where the first bundling guide 30a makes contact with the filaments F and the center of an area where the second bundling guide 30b makes contact with the filaments F. The area where the first bundling guide 30a makes contact with the filaments F is a right part of the circumferential surface of the first bundling guide 30a, which can make contact with the filaments F. The area where the second bundling guide 30b makes contact with the filaments F is similarly a left part of the circumferential surface of the second bundling guide 30b, which can make contact with the filaments F. When viewed in the front-rear direction, the distance between the first oil supply guide 51a and second oil supply guide 51b of the oiling unit 5 is the distance between the center of an area where the first oil supply surface 52a of the first oil supply guide 51a makes contact with the filaments F and the center of an area where the second oil supply surface 52b of the second oil supply guide 51b makes contact with the filaments F. The area where the first oil supply surface 52a of the first oil supply guide 51a makes contact with the filaments F is a part of the first oil supply guide 51a, which can make contact with the filaments F. The area where the second oil supply surface 52b of the second oil supply guide 51b makes contact with the filaments F is a part of the second oil supply surface 52b, which can make contact with the filaments F. The distance between the barycentric position of the first discharge port group 26A and that of the second discharge port group 26B is the distance between the barycentric position of the first discharge port group 26A viewed in the up-down direction and that of the second discharge port group 26B viewed in the up-down direction. The distance between the first bundling guide 30a and the second bundling guide 30b is equal to or more than 1 mm and equal to or less than 10 mm.

[0051] When viewed in the up-down direction, the first bundling guide 30a and the second bundling guide 30b are line-symmetric about the virtual partitioning plane X. The first bundling guide 30a and the second bundling guide 30b are moved to regulation positions (see FIG. 4) when the yarns Y are taken up by the godet rollers 8 and 9, and to yarn threading positions (see FIG. 7) when the filament groups are threaded to the respective bundling guides 30. The first bundling guide 30a and the second bundling guide 30b are movable between the respective regulation positions and the respective yarn threading positions. In the present embodiment, each bundling guide 30 is movable between a regulation position and a yarn threading position by moving in the left-right direction (indicated by a solid arrow in FIG. 7). To be more specific, the first bundling guide 30a is moved leftward from a regulation position to a yarn threading position. The second bundling guide 30b is moved rightward from a regulation position to a yarn threading position. The movement of each bundling guide 30 between a regulation position and a yarn threading position may be performed by an unillustrated motor or may be manually performed by the operator. As shown in FIG. 4 and FIG. 7, the distance between each two bundling guides 30 (the first bundling guide 30a and the second bundling guide 30b) at the yarn threading positions is longer than the distance between the two bundling guides 30 (the first bundling guide 30a and the second bundling guide 30b) at the regulation positions.

(Effects)

[0052] The yarn production system 1 of the present embodiment includes (i) the spinning apparatus 2 including each spinneret 24 provided with discharge ports 26, (ii) the cooler 4 provided below the spinneret 24, and (iii) each oiling unit 5 which is provided below the cooler 4 and which is configured to apply oil to filaments F which are divided into two groups and bundled as two yarns Y (the first yarn Y1 and the second yarn Y2). In this regard, the virtual partitioning plane X extending in the front-rear direction and the up-down direction divides the discharge ports 26 into the first discharge port group 26A provided for spinning out filaments F forming the first yarn Y1 and the second discharge port group 26B provided for spinning out filaments F forming the second yarn Y2. The oiling unit 5 includes two oil supply guides 51 (the first oil supply guide 51a and the second oil supply guide 51b). The first oil supply guide 51a includes (i) the first oil supply surface 52a with which the running first filament group formed of the filaments F forming the first yarn Y1 makes contact and (ii) the paired first yarn guiding members 53a. The second oil supply guide 51b includes (i) the second oil supply surface 52b with which the running second filament group formed of the filaments F forming the second yarn Y2 makes contact and (ii) the paired second yarn guiding members 53b. The yarn production system 1 further includes each two bundling guides 30. In this regard, the two bundling guides 30 (the first bundling guide 30a and the second bundling guide 30b) to which two filament groups are respectively threaded are provided below the cooler 4 and above the oiling unit 5.

The distance between the first bundling guide 30a and the second bundling guide 30b in the left-right direction is shorter than (i) the distance between the first oil supply guide 51a and second oil supply guide 51b of the oiling unit 5 and (ii) the distance between the barycentric position of the first discharge port group 26A and that of the second discharge port group 26B in the left-right direction. When viewed in the up-down direction, (i) the first oil supply guide 51a is provided on the same side as the first discharge port group 26A with respect to the virtual partitioning plane X and (ii) the second oil supply guide 51b is provided on the same side as the second discharge port group 26B with respect to the virtual partitioning plane X. The first oil supply surface 52a extends in the up-down direction and the predetermined first width direction D1 which is the horizontal direction, and the second oil supply surface 52b extends in the up-down direction and the predetermined second width direction D2 which is the horizontal direction. Assume that, when (i) the first width direction D1 is in parallel to the virtual partitioning plane X and (ii) the first oil supply surface 52a is oriented in the direction opposite to the direction in which the first oil supply surface 52a faces the virtual partitioning plane X, the angle between the first width direction D1 and the virtual partitioning plane X viewed in the up-down direction is 0 degree. In this case, the angle between the first width direction D1 and the virtual partitioning plane X viewed in the up-down direction is within the range of 90 to -90 degrees. Assume that, when (i) the second width direction D2 is in parallel to the virtual partitioning plane X and (ii) the second oil supply surface 52b is oriented in the direction opposite to the direction in which the second oil supply surface 52b faces the virtual partitioning plane X, the angle between the second width direction D2 and the virtual partitioning plane X viewed in the up-down direction is 0 degree. In this case, the angle between the second width direction D2 and the virtual partitioning plane X viewed in the up-down direction is within the range of 90 to -90 degrees.

[0053] In the present embodiment, the first filament group spun out from the spinneret 24 is threaded to the first bundling guide 30a provided above the oiling unit 5, and the second filament group spun out from the spinneret 24 is threaded to the second bundling guide 30b provided above the oiling unit 5. The distance between the first bundling guide 30a and the second bundling guide 30b in the left-right direction is shorter than (i) the distance between the first oil supply guide 51a and the second oil supply guide 51b in the left-right direction and (ii) the distance between the barycentric position of the first discharge port group 26A and that of the second discharge port group 26B in the left-right direction. With this arrangement, two filament groups running from the spinneret 24 to the respective oil supply guides 51 are threaded to the two bundling guides 30 provided above the oiling unit 5 so as to be temporally bundled. Therefore, a space formed between the two filament groups running from the spinneret 24 to the respective oil supply guides 51, i.e., between the two filament groups passing an area where the cooling wind from the cooler 4 blows is made small. This suppresses the disturbance of airflows caused by the inflow of the cooling wind from the cooler 4 into the space, and thus each filament F is properly blown by the cooling wind. It is therefore possible to properly cool the filaments F.

[0054] In the present embodiment, the first oil supply guide 51a is provided on the same side as the first discharge port group 26A with respect to the virtual partitioning plane X, and the second oil supply guide 51b is provided on the same side as the second discharge port group 26B with respect to the virtual partitioning plane X. That is, the virtual partitioning plane X is provided between the first oil supply guide 51a and the second oil supply guide 51b. In the present embodiment, each of (i) the angle between the first width direction D1 and the virtual partitioning plane X and (ii) the angle between the second width direction D2 and the virtual partitioning plane X is within the range of 90 to - 90 degrees. That is, the first oil supply surface 52a does not face the virtual partitioning plane X. The same applies to the second oil supply surface 52b. With these arrangements, when the first filament group is threaded to the first oil supply surface 52a, yarn threading of the first filament group does not need to be performed from the virtual partitioning plane X provided between the first oil supply guide 51a and the second oil supply guide 51b. As a result, the second oil supply guide 51b does not disturb the yarn threading. The same applies to the case where the second filament group is threaded to the second oil supply surface 52b. Therefore, each filament group is easily threaded to a corresponding oil supply surface 51.

[0055] In the yarn production system 1 of the present embodiment, the first discharge port group 26A is arranged so that (i) discharge ports 26 belonging to the first discharge port group 26A form first lines extending along the front-rear direction (predetermined width direction) and second lines extending in a direction intersecting with the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26, and the second discharge port group 26B is arranged so that (i) discharge ports 26 belonging to the second discharge port group 26B form first lines extending along the front-rear direction (predetermined width direction) and second lines extending in the direction intersecting with the front-rear direction, i.e., in a direction different from the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26. Furthermore, when viewed in the up-down direction, each of (i) the angle between the first width direction D1 and the virtual partitioning plane X and (ii) the angle between the second width direction D2 and the virtual partitioning plane X is within the range of 45 to -45 degrees. In the present embodiment, when viewed in the up-down direction, filaments F spun out from the first discharge port group 26A and the second discharge port group 26B run downward toward an oiling unit 5 while being aligned in the front-rear direction (the predetermined width direction) in which the virtual partitioning plane X extends. In this regard, the filaments F are most widely dispersed in the front-rear direction. Furthermore, when viewed in the up-down direction, each of (i) the angle between the first width direction D1 and the virtual partitioning plane X and (ii) the angle between the second width direction D2 and the virtual partitioning plane X is within the range of 45 to -45 degrees. Because of this, when viewed in the up-down direction, an angle between a direction in which the filaments F spun out from the first discharge port group 26A are most widely dispersed (i.e., the front-rear direction) and the first width direction D1 of the first oil supply surface 52a is arranged to be as small as possible. Similarly, an angle between a direction in which the filaments F spun out from the second discharge port group 26B are most widely dispersed (i.e., the front-rear direction) and the second width direction D2 of the second oil supply surface 52b is arranged to be as small as possible. As a result, the filaments F spun out from each of the discharge port groups 26A and 26B make contact with corresponding one of the oil supply surfaces 52a and 52b while the filaments F are dispersed as widely as possible. This reduces an overlap between adjacent filaments F, and thus the number of filaments F which directly make contact with the oil supply surface 52a or the oil supply surface 52b is maximized. It is therefore possible to efficiently apply oil to the filaments F.

[0056] In the yarn production system 1 of the present embodiment, when viewed in the up-down direction, the first discharge port group 26A and the second discharge port group 26B are line-symmetric about the virtual partitioning plane X, the first bundling guide 30a and the second bundling guide 30b are line-symmetric about the virtual partitioning plane X, and the first oil supply surface 52a and the second oil supply surface 52b are line-symmetric about the virtual partitioning plane X. The filaments F spun out from two discharge port groups 26A and 26B of the spinneret 24 are cooled by means of the cooling wind supplied from the cooler 4 provided between the spinning apparatus 2 and the oiling unit 5. In the present embodiment, the following paths are plane-symmetric about the virtual partitioning plane X: a path of the first filament group, which is spun out from the first discharge port group 26A, to the first oil supply surface 52a via the first bundling guide 30a; and a path of the second filament group, which is spun out from the second discharge port group 26B, to the second oil supply surface 52a via the second bundling guide 30b. With this arrangement, the filaments F spun out from the first discharge port group 26A are identical with the filaments F spun out from the second discharge port group 26B in regard to the length of a path on which the filaments F are blown by the cooling wind from the cooler 4 provided between the spinning apparatus 2 and the oiling unit 5. It is therefore possible to equalize the quality of the two yarns Y (the first yarn Y1 and the second yarn Y2) formed of the filaments F spun out from the two discharge port groups 26A and 26B of the spinneret 24.

[0057] In the present embodiment, when viewed in the up-down direction, (i) the two bundling guides 30 are line-symmetric about the virtual partitioning plane X and (ii) the two oil supply guides 51 are line-symmetric about the virtual partitioning plane X. Furthermore, two yarn path regulatory guides 6 are provided downstream of each oiling unit 5. With this arrangement, the first filament group and the second filament group are threaded to the two bundling guides 30. Below the two bundling guides 30, the first filament group and the second filament group in each of which the filaments F are widely dispersed in the left-right direction are threaded to the two oil supply guides 51. On the downstream side of the two oil supply guides 51, the first filament group and the second filament group are threaded to the yarn path regulatory guides 6. In the present embodiment, the first oil supply surface 52a and the second oil supply surface 52b are provided back to back. The distance between the two oil supply guides 51 in the left-right direction is longer than (i) the distance between the two bundling guides 30 and (ii) the distance between the two yarn path regulatory guides 6 in the left-right direction. With this arrangement, the first filament group and the second filament group are threaded to outer parts of the two oil supply guides 51 in the left-right direction and pressed onto the respective oil supply surfaces 52a and 52b of the two oil supply guides 51. In the present embodiment, the first oil supply surface 52a is provided with the paired first yarn guiding members 53a, and the second oil supply surface 52b is provided with the paired second yarn guiding members 53b. With this arrangement, each filament group is less likely to be detached from a corresponding oil supply guide 51.

[0058] In the yarn production system 1 of the present embodiment, the godet rollers 8 and 9 for taking up yarns Y are provided downstream of the oiling unit 5 in the yarn running direction. The first bundling guide 30a and the second bundling guide 30b are moved to the regulation positions when the yarns Y are taken up by the godet rollers 8 and 9, and to the yarn threading positions when the filament groups are threaded to the respective bundling guides 30. The first bundling guide 30a and the second bundling guide 30b are movable between the respective regulation positions and the respective yarn threading positions. The distance between the two bundling guides 30 (the first bundling guide 30a and the second bundling guide 30b) at the yarn threading positions is longer than the distance between the two bundling guides 30 (the first bundling guide 30a and the second bundling guide 30b) at the regulation positions. With this arrangement, the filament groups are easily threaded to the respective bundling guides 30 by moving the two bundling guides 30 to the yarn threading positions.

[0059] In the yarn production system 1 of the present embodiment, each bundling guide 30 is a bar guide. In the present embodiment, a filament group is easily threaded to each bundling guide 30 by simply placing the filament group along the bundling guide 30 which is a bar guide. The filaments F make contact with the bundling guide 30 while being distributed in the extending direction of the bundling guide 30 which is a bar guide. In this regard, oil is not applied yet to the filaments F threaded to the bundling guide 30. When many filaments F are threaded to the bundling guide 30 while overlapping one another, the quality of the filaments F is greatly and disadvantageously influenced. The present embodiment makes it possible to solve the above-described problem, and to ensure the quality of the filaments F.

[0060] In the yarn production system 1 of the present embodiment, each bundling guide 30 which is a bar guide is rotatable about its axial center extending in the extending direction (the front-rear direction) of the bundling guide 30. In the present embodiment, a friction force on filaments F in contact with the bundling guide 30 is decreased by rotating the bundling guide 30 which is a bar guide in accordance with the running of a filament group threaded to the bundling guide 30. This suppresses the decrease in quality of a yarn Y formed of each filament group.

[0061] In the yarn production system 1 of the present embodiment, the distance between the first bundling guide 30a and the second bundling guide 30b which are adjacent to one another is equal to or more than 1 mm and equal to or less than 10 mm. When the distance between the two adjacent bundling guides 30 is too short, filament groups threaded to the two adjacent bundling guides 30 may be tangled with one another. Meanwhile, when the distance between the two adjacent bundling guides 30 is too long, two filament groups cannot be bundled between the spinneret 24 and the two oil supply guides 51. This puts a limit on the decrease in size of a space formed between the two filament groups running between the spinneret 24 and the two oil supply guides 51. The present embodiment makes it possible to solve the above-described problem, to suppress the tangle of the two filament groups threaded to the respective bundling guides 30, and to further decrease the size of a space formed between the two filament groups running between the spinneret 24 and the two oil supply guides 51.

[0062] In the yarn production system 1 of the present embodiment, the cooler 4 is an annular cooler in which the entire circumference of each running filament F is blown by the cooling wind. When the entire circumference of each filament F is blown by the cooling wind from the annular cooler, a lot of the cooling wind easily enters a space formed between filament groups running between the spinneret 24 and the two oil supply guides 51. Furthermore, the disturbance of airflows easily occurs in the space. In the present embodiment, the annular cooler makes it possible to effectively suppress the disturbance of airflows caused by the inflow of the cooling wind from the cooler 4 into the space. It is therefore possible to further properly cool the filaments F.

[0063] In the yarn production system 1 of the present embodiment, each bundling guide 30 is closer to the cooler 4 than to the oiling unit 5 in the up-down direction. In the present embodiment, the two filament groups running between the spinneret 24 and the two oil supply guides 51 are temporarily bundled at a position closer to the cooler 4 than to the two oil supply guides 51 in the up-down direction. This further decreases the size of a space formed between two filament groups running from the spinneret 24 to the two bundling guides 30, i.e., between the two filament groups passing the cooler 4.

(Modifications)

[0064] 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.

[0065] In the embodiment above, each bundling guide 30 is movable between the regulation position and the yarn threading position. However, each bundling guide 30 may be fixed at the regulation position.

[0066] In the embodiment above, the distance between each first bundling guide 30a and each second bundling guide 30b is equal to or more than 1 mm and equal to or less than 10 mm. However, the disclosure is not limited to this. For example, the distance between the first bundling guide 30a and the second bundling guide 30b may be less than 1 mm or more than 10 mm.

[0067] In the embodiment above, the cooler 4 is an annular cooler. However, the cooler 4 may be structured so that each running filament F is partially blown by the cooling wind in the entire circumferential direction of the filament F.

[0068] In the embodiment above, when viewed in the up-down direction, each first discharge port group 26A and each second discharge port group 26B are line-symmetric about the virtual partitioning plane X, each first bundling guide 30a and each second bundling guide 30b are line-symmetric about the virtual partitioning plane X, and each first oil supply surface 52a and each second oil supply surface 52b are line-symmetric about the virtual partitioning plane X. However, the disclosure is not limited to these arrangements. For example, the first discharge port group 26A and the second discharge port group 26B may not be line-symmetric about the virtual partitioning plane X. The first bundling guide 30a and the second bundling guide 30b may not be line-symmetric about the virtual partitioning plane X. The first oil supply surface 52a and the second oil supply surface 52b may not be line-symmetric about the virtual partitioning plane X.

[0069] In the embodiment above, each bundling guide 30 is closer to the cooler 4 than to an oiling unit 5 in the up-down direction. However, the bundling guide 30 may be closer to the oiling unit 5 than to the cooler 4 in the up-down direction.

[0070] In the embodiment above, the comb teeth guide 7 which is provided with the grooves (not illustrated) formed at regular intervals in the left-right direction is provided below the yarn path regulatory guides 6. However, a guide which is not a comb teeth guide may be provided below the yarn path regulatory guides 6. It is possible to use, e.g., a guide such as a U-shaped guide in which a single yarn running portion for guiding yarns Y is provided at a single guide member.

[0071] In the embodiment above, the spinning beam 21 is rectangular in plan view and long in the left-right direction. However, for example, the spinning beam 21 may be circular in plan view. In this case, the spinning packs 22 are provided along the circular spinning beam 21.

[0072] In the embodiment above, each bundling guide 30 which is a bar guide is freely rotatable. However, the bundling guide 30 which is a bar guide may be rotated by, e.g., a motor. The bundling guide 30 is not limited to a bar guide. To be more specific, when viewed in the front-rear direction, a part of the bundling guide 30 of the embodiment above makes contact with a yarn Y and is a curved surface along the circumference of the bundling guide 30. However, when viewed in the front-rear direction, the bundling guide 30 which partially makes contact with a yarn Y may be a curved surface irrespective of the circumference of the bundling guide 30 or may not be a curved surface.

[0073] In the embodiment above, each spinneret 24 is substantially circular in shape when viewed from below. However, the spinneret 24 may not be circular in shape. For example, the spinneret 24 may be polygonal in shape. In the embodiment above, the first discharge port group 26A is arranged so that (i) discharge ports 26 belonging to the first discharge port group 26A form first lines extending along the front-rear direction (predetermined width direction) and second lines extending in a direction intersecting with the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26, and the second discharge port group 26B is arranged so that (i) discharge ports 26 belonging to the second discharge port group 26B form first lines extending along the front-rear direction (predetermined width direction) and second lines extending in the direction intersecting with the front-rear direction, i.e., in a direction different from the front-rear direction, (ii) one of the first lines has more discharge ports 26 than the first lines, (iii) one of the second lines has more discharge ports 26 than the second lines, and (iv) the one of the first lines is larger than the one of the second lines in terms of the number of the discharge ports 26. However, in each of the first discharge port group 26A and the second discharge port group 26B, the one of the first lines may not be larger than the one of the second lines in terms of the number of the discharge ports 26.

[0074] In the embodiment above, the first discharge port group 26A is arranged so that discharge ports 26 of the first discharge port group 26A form plural first lines extending in the front-rear direction. However, the first discharge port group 26A may be arranged so that discharge ports 26 of the first discharge port group 26A form a single first line extending in the front-rear direction. Furthermore, the second discharge port group 26B is arranged so that discharge ports 26 of the second discharge port group 26B form plural first lines extending in the front-rear direction. However, the second discharge port group 26B may be arranged so that discharge ports 26 of the second discharge port group 26B form a single first line extending in the front-rear direction.

[0075] In the embodiment above, when viewed in the up-down direction, the angle between the first width direction D1 and the virtual partitioning plane X is 0 degree. However, the angle between the first width direction D1 and the virtual partitioning plane X may not be 0 degree as long as this angle is within the range of 90 to -90 degrees. The definition of 90 degrees and that of -90 degrees are described above. The same applies to the angle between the second width direction D2 and the virtual partitioning plane X.

Claims

1. A yarn production system (1) comprising: a spinning apparatus (2) including a spinneret (24) provided with discharge ports (26) through which filaments (F) are spun out downward;

a cooler (4) which is provided below the spinneret (24) and which is configured to cool the filaments (F) by means of cooling wind; and
an oiling unit (5) which is provided below the cooler (4) and which is configured to apply oil to a first yarn (Y1) and a second yarn (Y2), the filaments (F) being divided into two groups and bundled as the first yarn (Y1) and the second yarn (Y2),
the discharge ports (26) being divided into a first discharge port group (26A) through which filaments (F) forming the first yarn (Y1) are spun out and a second discharge port group (26B) through which filaments (F) forming the second yarn (Y2) are spun out, by a virtual partitioning plane (X) extending in a vertical direction and a predetermined width direction intersecting with the vertical direction,
the oiling unit (5) including: a first oil supply guide

(51a) including a first oil supply surface (52a) with which a running first filament group formed of the filaments (F) forming the first yarn (Y1) makes contact and a pair of first yarn guiding members (53a) provided on both sides of the first oil supply surface (52a) in a horizontal direction to guide the first filament group toward the first oil supply surface (52a); and

a second oil supply guide (51b) including a second oil supply surface (52b) with which a running second filament group formed of the filaments (F) forming the second yarn (Y2) makes contact and a pair of second yarn guiding members (53b) provided on both sides of the second oil supply surface (52b) in the horizontal direction to guide the second filament group toward the second oil supply surface (52b),

the yarn production system (1) further comprising: a first bundling guide (30a) which is provided below the cooler (4) and above the oiling unit (5) and to which the first filament group is threaded; and

a second bundling guide (30b) which is provided below the cooler (4) and above the oiling unit (5) and to which the second filament group is threaded,

the distance between the first bundling guide (30a) and the second bundling guide (30b) in the horizontal direction being shorter than (i) the distance between the first oil supply guide (51a) and the second oil supply guide (51b) and (ii) the distance between the barycentric position of the first discharge port group (26A) and the barycentric position of the second discharge port group (26B) in the horizontal direction,

the first oil supply guide (51a) being provided on the same side as the first discharge port group (26A) with respect to the virtual partitioning plane (X) when viewed in the vertical direction,

the second oil supply guide (51b) being provided on the same side as the second discharge port group (26B) with respect to the virtual partitioning plane (X) when viewed in the vertical direction,

the first oil supply surface (52a) extending in an up-down direction and a predetermined first width direction (D1) which is the horizontal direction,

the second oil supply surface (52b) extending in the up-down direction and a predetermined second width direction (D2) which is the horizontal direction,

when an angle between the first width direction (D1) and the virtual partitioning plane (X) viewed in the vertical direction is 0 degree in a case where (i) the first width direction (D1) is in parallel to the virtual partitioning plane (X) and (ii) the first oil supply surface (52a) is oriented in a direction opposite to a direction in which the first oil supply surface (52a) faces the virtual partitioning plane (X),

the angle between the first width direction (D1) and the virtual partitioning plane (X) viewed in the vertical direction being within the range of 90 to -90 degrees,

when an angle between the second width direction (D2) and the virtual partitioning plane (X) viewed in the vertical direction is 0 degree in a case where (i) the second width direction (D2) is in parallel to the virtual partitioning plane (X) and (ii) the second oil supply surface (52b) is oriented in a direction opposite to a direction in which the second oil supply surface (52b) faces the virtual partitioning plane (X), and

the angle between the second width direction (D2) and the virtual partitioning plane (X) viewed in the vertical direction being within the range of 90 to -90 degrees.

2. The yarn production system (1) according to claim 1, wherein, the first discharge port group (26A) is arranged so that (i) discharge ports (26) belonging to the first discharge port group (26A) form at least one first line extending in the predetermined width direction and at least one second line extending in a direction intersecting with the predetermined width direction, (ii) one of the at least one first line has more discharge ports (26) than the at least one first line, (iii) one of the at least one second line has more discharge ports (26) than the at least one second line, and (iv) the one of the at least one first line is larger than the one of the at least one second line in terms of the number of the discharge ports,

the second discharge port group (26B) is arranged so that (i) discharge ports (26) belonging to the second discharge port group (26B) form at least one first line extending in the predetermined width direction and at least one second line extending in the direction intersecting with the predetermined width direction, (ii) one of the at least one first line has more discharge ports (26) than the at least one first line, (iii) one of the at least one second line has more discharge ports (26) than the at least one second line, and (iv) the one of the at least one first line is larger than the one of the at least one second line in terms of the number of the discharge ports, and when viewed in the vertical direction, each of the angle between the first width direction (D1) and the virtual partitioning plane (X) and the angle between the second width direction (D2) and the virtual partitioning plane (X) is within the range of 45 to -45 degrees.

3. The yarn production system (1) according to claim

2, wherein, when viewed in the vertical direction,

the first discharge port group (26A) and the second discharge port group (26B) are line-symmetric about the virtual partitioning plane (X),
the first bundling guide (30a) and the second bundling guide (30b) are line-symmetric about the virtual partitioning plane (X), and
the first oil supply surface (52a) and the second oil supply surface (52b) are line-symmetric about the virtual partitioning plane (X).

4. The yarn production system (1) according to any one of claims 1 to 3, wherein, a take-up roller (8, 9) for taking up the first yarn (Y1) and the second yarn (Y2) is provided downstream of the oiling unit (5) in a yarn running direction in which the first yarn (Y1) and the second yarn (Y2) run,

the first bundling guide (30a) and the second bundling guide (30b) are movable between regulation positions and yarn threading positions,
the first bundling guide (30a) is moved to one of the regulation positions when the first yarn (Y1) is taken up by the take-up roller (8, 9) and to one of the yarn threading positions when the first filament group is threaded to the first bundling guide (30a),
the second bundling guide (30b) is moved to the other of the regulation positions when the second yarn (Y2) is taken up by the take-up roller (8, 9) and to the other of the yarn threading positions when the second filament group is threaded to the second bundling guide (30b), and
the distance between the first bundling guide (30a) at the one of the yarn threading positions and the second bundling guide (30b) at the other of the yarn threading positions is longer than the distance between the first bundling guide (30a) at the one of the regulation positions and the second bundling guide (30b) at the other of the regulation positions.

5. The yarn production system (1) according to any one of claims 1 to 4, wherein, the first bundling guide (30a) and the second bundling guide (30b) are bar guides.

6. The yarn production system (1) according to claim 5, wherein, each of the bar guides is rotatable about the axial center of the each of the bar guides, and the axial center of the each of the bar guides extends in an extending direction of the each of the bar guides.

7. The yarn production system (1) according to any one of claims 1 to 6, wherein, the distance between the first bundling guide (30a) and the second bundling guide (30b) is equal to or more than 1 mm and equal to or less than 10 mm.

8. The yarn production system (1) according to any one of claims 1 to 7, wherein, the cooler (4) is an annular cooler (4) in which the entire circumference of each of the running filaments (F) is blown by the cooling wind.

9. The yarn production system (1) according to any one of claims 1 to 8, wherein, the first bundling guide (30a) and the second bundling guide (30b) are closer to the cooler (4) than to the oiling unit (5) in the vertical direction.

FIG.1

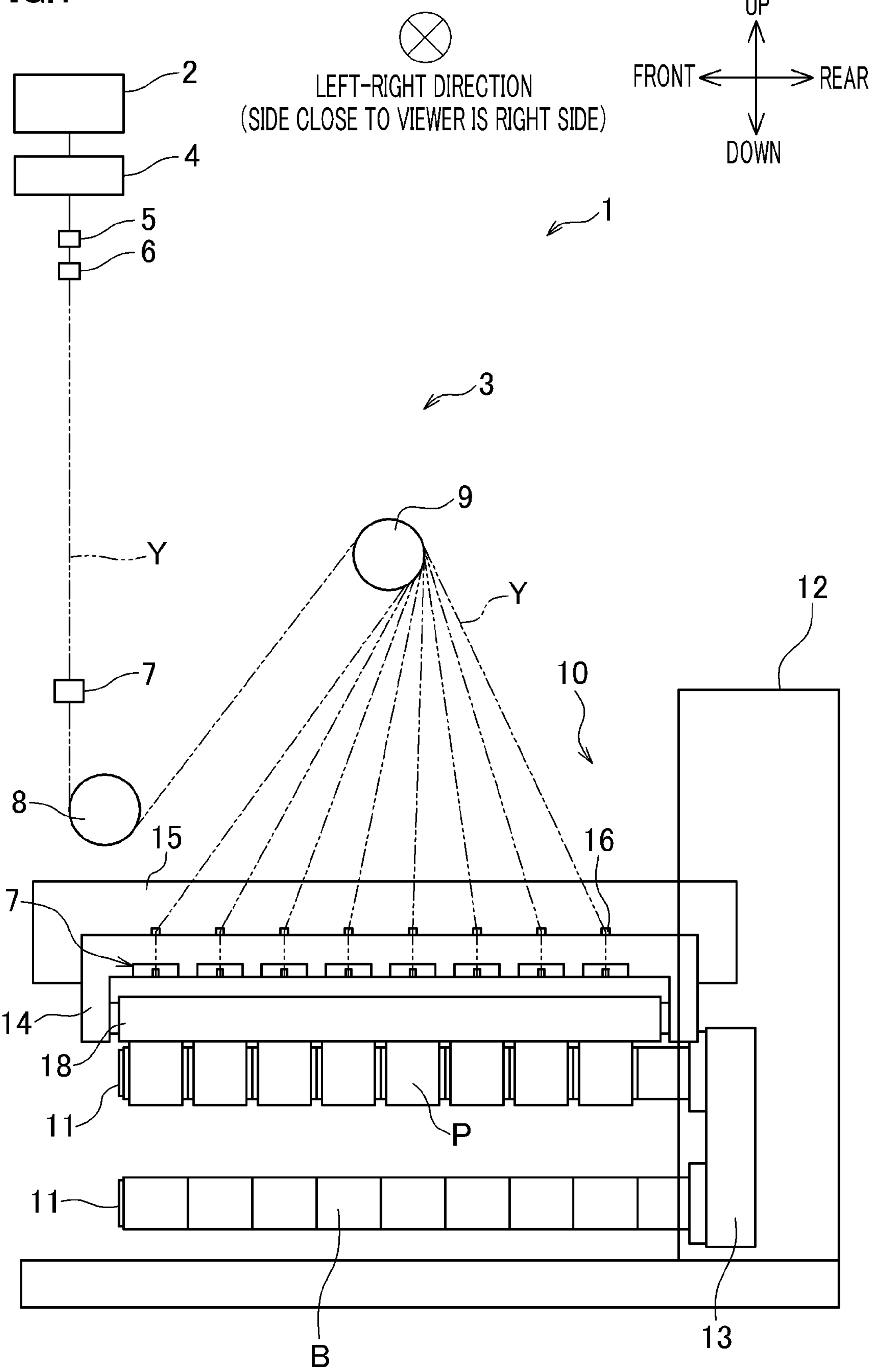

LEFT-RIGHT DIRECTION
(SIDE CLOSE TO VIEWER IS RIGHT SIDE)
UP
FRONT
REAR
DOWN
1
2
4
5
6
3
9
Y
Y
12
7
10
8
15
16
17
14
18
11
P
11
B
13

FIG.2

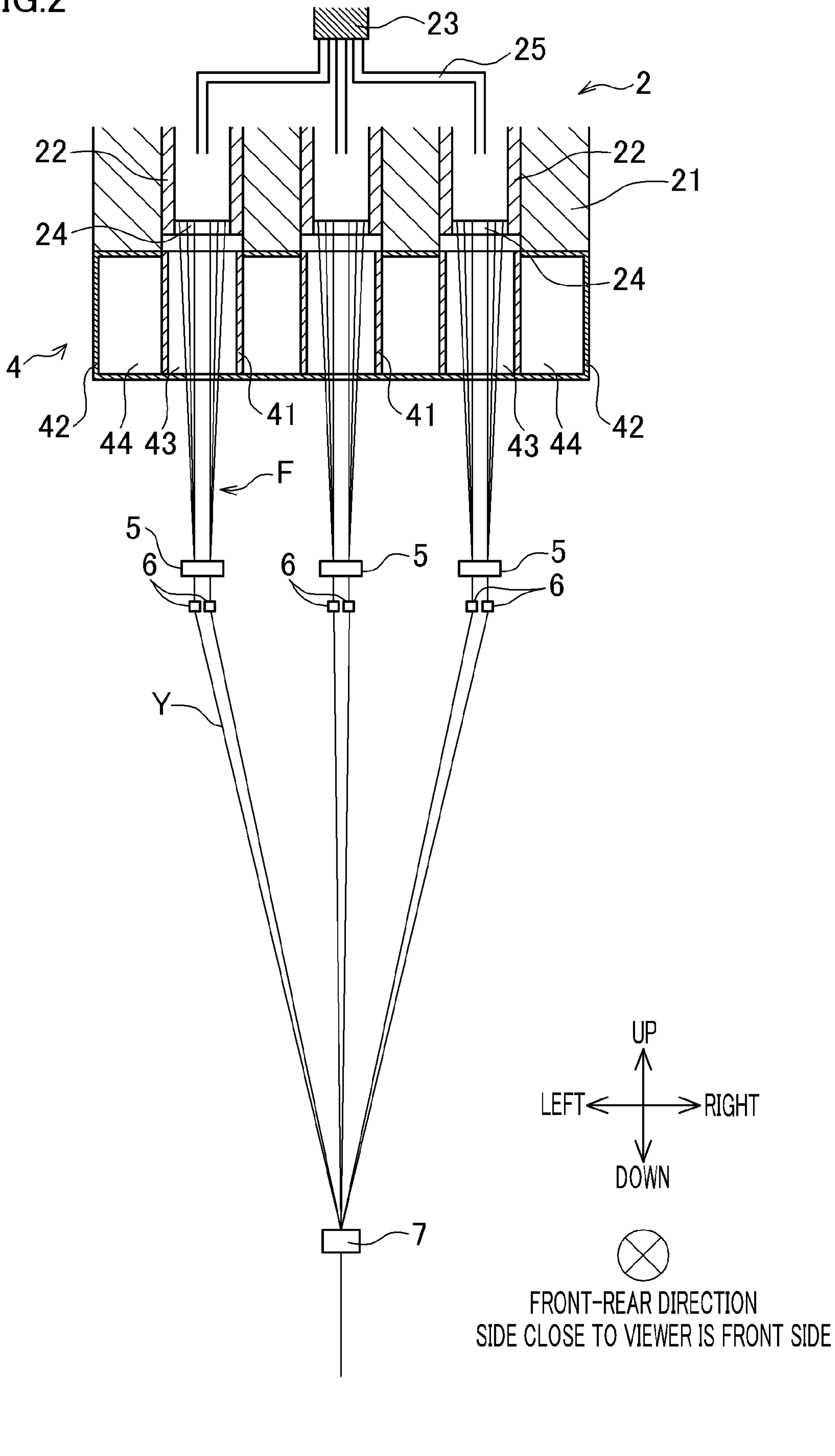

23
25
2
22
22
21
24
24
4
42
44
43
41
41
43
44
42
F
5
5
5
6
6
6
Y
7
UP
LEFT
RIGHT
DOWN
FRONT-REAR DIRECTION
SIDE CLOSE TO VIEWER IS FRONT SIDE

FIG.3

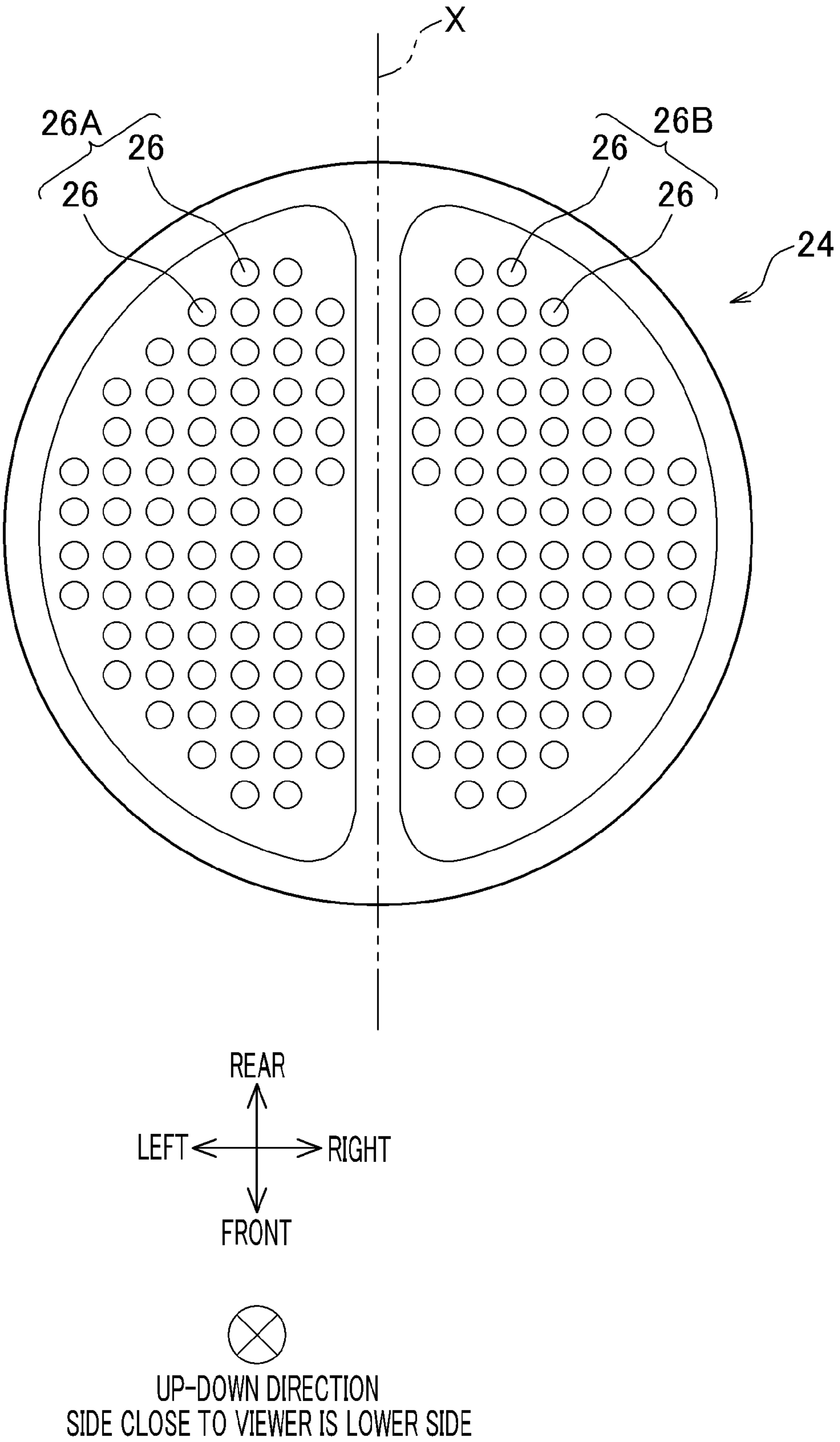

X
26A
26
26
26B
26
26
24
REAR
LEFT
RIGHT
FRONT
UP-DOWN DIRECTION
SIDE CLOSE TO VIEWER IS LOWER SIDE

FIG.4

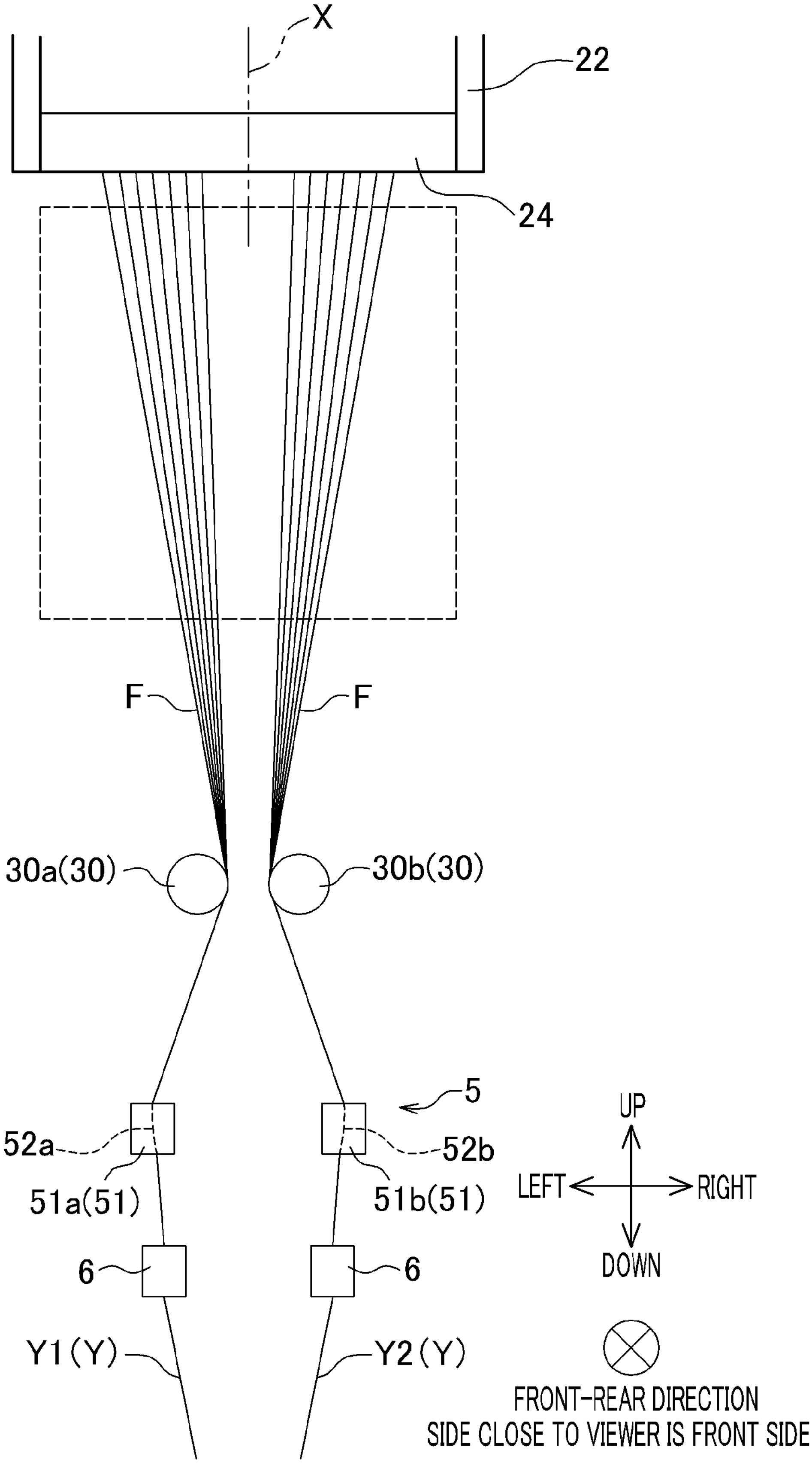

X
22
24
F
F
30a(30)
30b(30)
5
52a
52b
51a(51)
51b(51)
UP
LEFT
RIGHT
DOWN
6
6
Y1(Y)
Y2(Y)
FRONT-REAR DIRECTION
SIDE CLOSE TO VIEWER IS FRONT SIDE

FIG.5

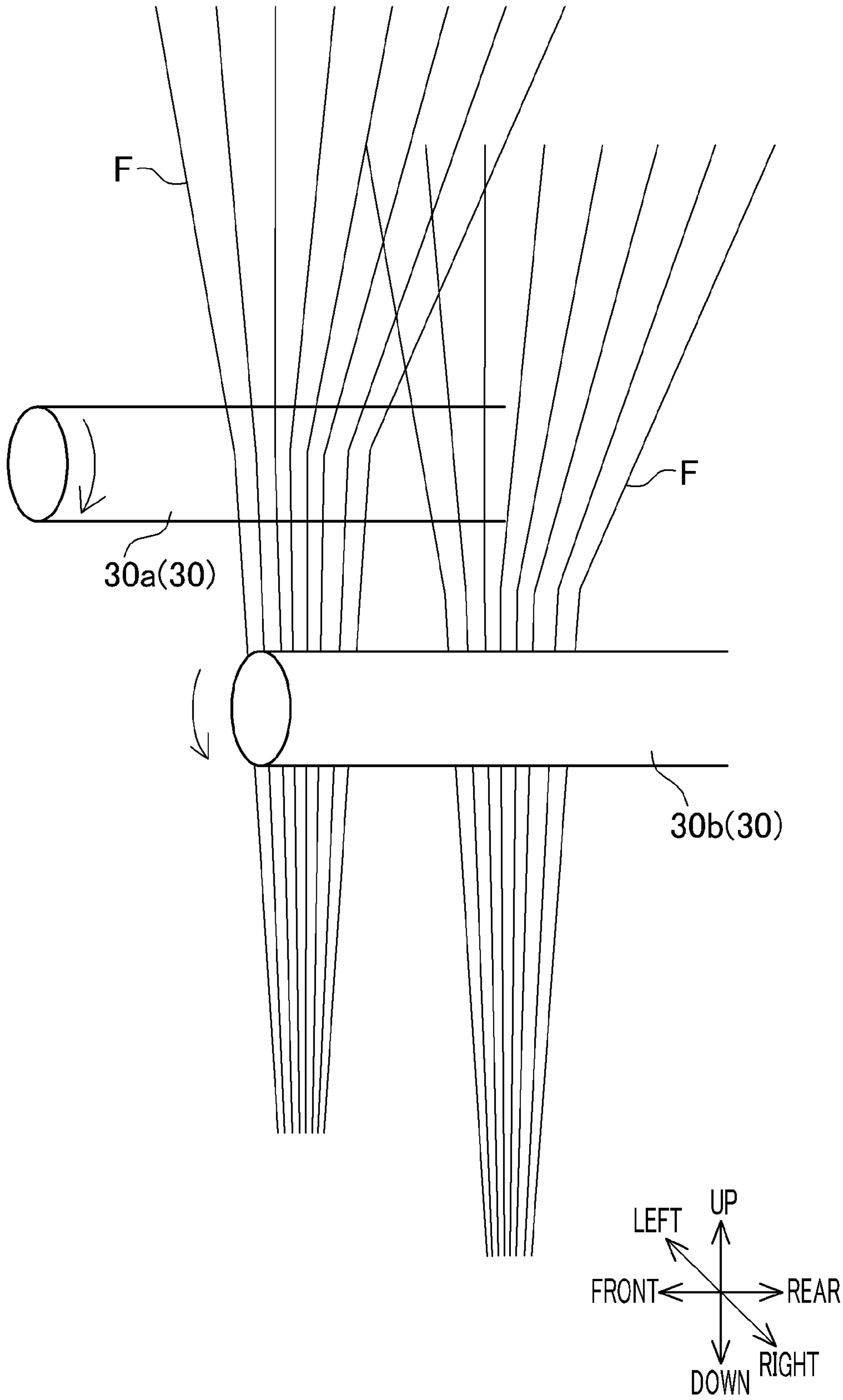


FIG.6

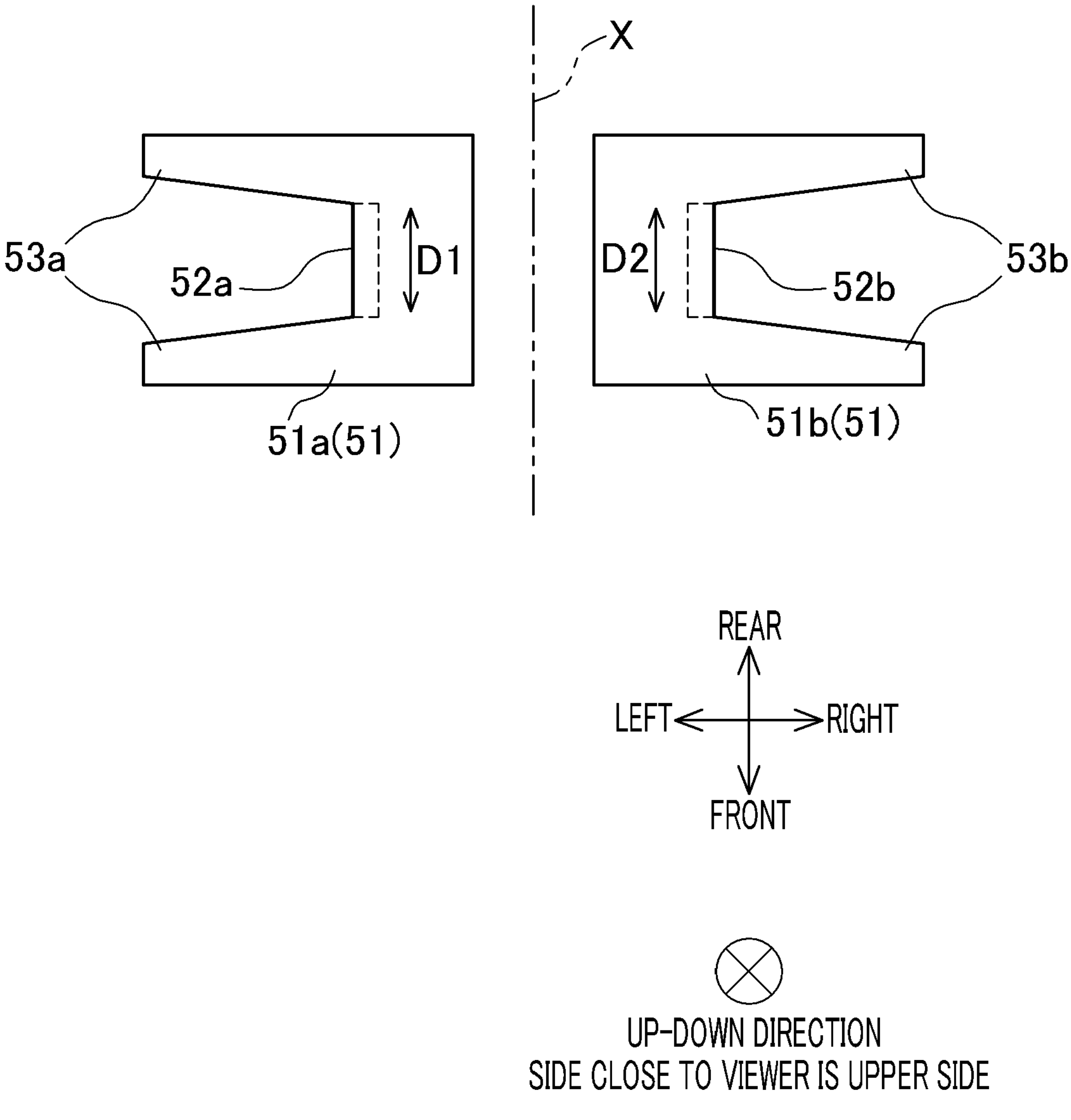
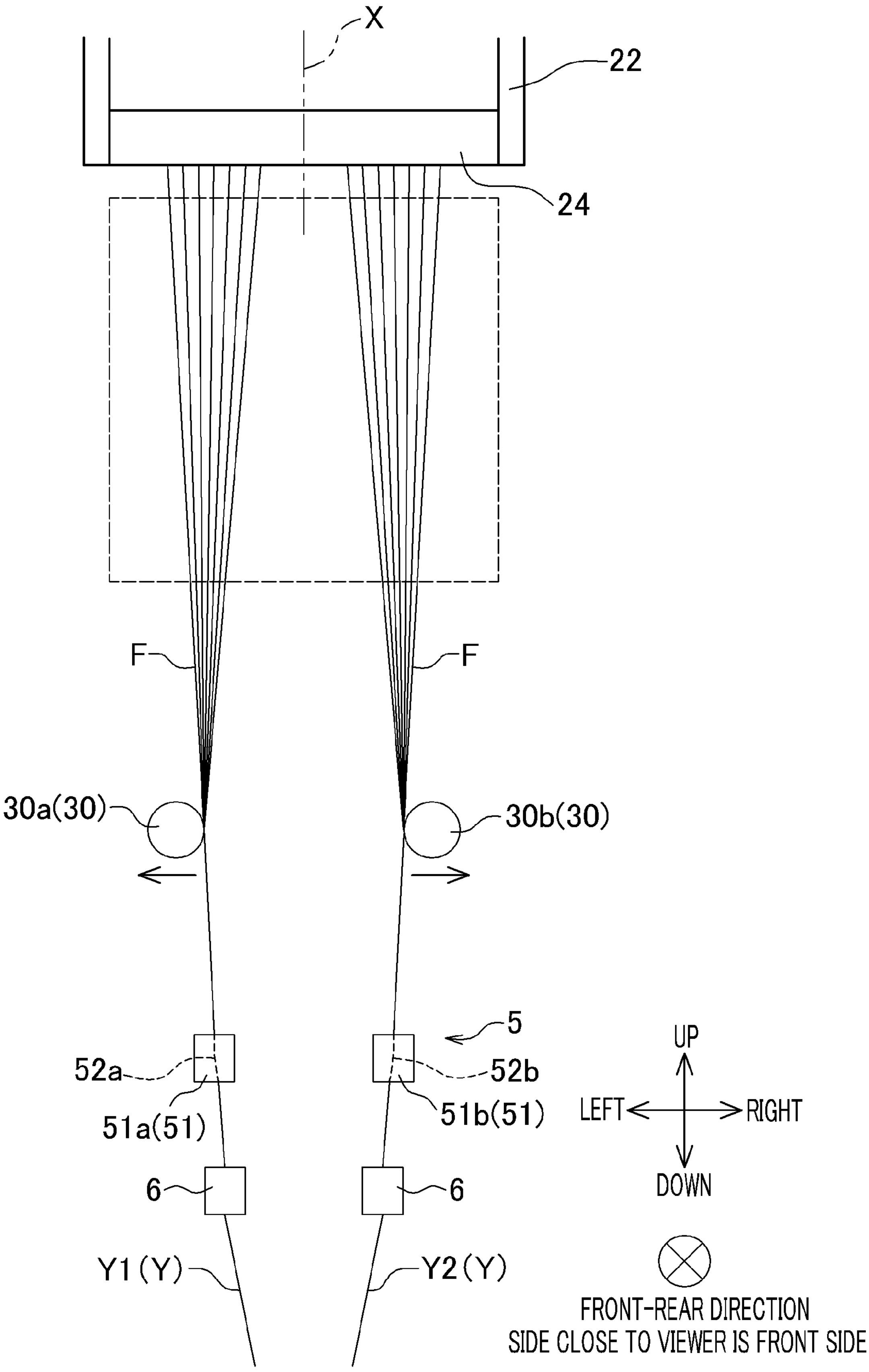

X
53a
52a
D1
51a(51)
D2
52b
53b
51b(51)
REAR
LEFT
RIGHT
FRONT
UP-DOWN DIRECTION
SIDE CLOSE TO VIEWER IS UPPER SIDE

FIG.7


X
22
24
F
F
30a(30)
30b(30)
5
52a
52b
51a(51)
51b(51)
6
6
Y1(Y)
Y2(Y)
UP
LEFT
RIGHT
DOWN
FRONT-REAR DIRECTION
SIDE CLOSE TO VIEWER IS FRONT SIDE

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EUROPEAN SEARCH REPORT

Application Number
EP 23 22 0477

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2006/145385 A1 (FUJII TAKASHI [JP] ET AL) 6 July 2006 (2006-07-06) * paragraphs [0009], [0018], [0040] - [0045], [0098], [0173]; figures 1-5,28,29 *	1-9	INV. D01D5/096 D01D5/088 D01D5/092 D01D13/02
Y	JP 2014 133969 A (TMT MACHINERY INC) 24 July 2014 (2014-07-24) * paragraphs [0013], [0020], [0023], [0025], [0028], [0029], [0030], [0046]; figures 1,2a,2b,3, *	1-9	
A	JP S59 168112 A (KURARAY CO) 21 September 1984 (1984-09-21) * page 53, column 7; claim 1; figures 1-5 *	1-9	
A	JP H10 245713 A (NIPPON ESTER CO LTD) 14 September 1998 (1998-09-14) * paragraphs [0005], [0013], [0014] *	1	

TECHNICAL FIELDS SEARCHED (IPC)

D01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 June 2024	Van Beurden-Hopkins

2

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons
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18-06-2024

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