



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.01.2023 Bulletin 2023/01

(51) International Patent Classification (IPC):
D02J 13/00 ^(2006.01) **D02G 1/02** ^(2006.01)

(21) Application number: **22175113.4**

(52) Cooperative Patent Classification (CPC):
D02J 13/003; D02G 1/0206

(22) Date of filing: **24.05.2022**

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

(72) Inventors:

- Demizu, Yoshimitsu
Kyoto-shi, Kyoto 612-8686 (JP)
- Kitagawa, Shigeki
Kyoto-shi, Kyoto 612-8686 (JP)
- Horimoto, Takayuki
Kyoto-shi, Kyoto 612-8686 (JP)

(30) Priority: 09.06.2021 JP 2021096622

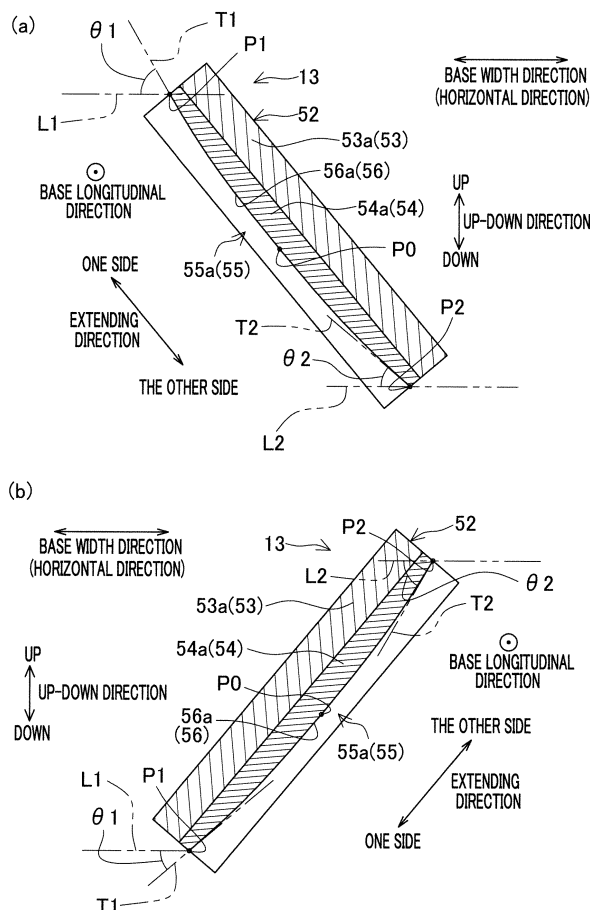
(74) Representative: **Hoffmann Eitle
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)**

(71) Applicant: **TMT Machinery, Inc.**
Osaka-shi, Osaka 541-0041 (JP)

(54) **MANUFACTURING METHOD OF PROCESSED YARN AND YARN PROCESSOR**

(57) An object of the present invention is to increase, when a yarn is heated and processed in a heater, a heating efficiency while avoiding risk of fusion in yarn breakage. A manufacturing method of processed yarns includes a step of heating a running yarn Y, which is made of synthetic fibers, by means of a first heater 13. The first heater 13 includes a heat source 51 and a heating unit 52. The heating unit 52 includes a contact surface 56 extending at least in a predetermined extending direction. The running yarn Y makes contact with the contact surface 56. In the manufacturing method, the contact surface 56 is oriented at least downward. Furthermore, the first heater 13 is provided so that an inclination angle of the contact surface 56 with respect to the horizontal direction is within a range of - 60 to 60 degrees in a cross section parallel to both a vertical direction and the extending direction. Furthermore, the temperature of the contact surface 56 is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade. The yarn Y runs in this state while making contact with the contact surface 56.

FIG.5



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to (i) a method of manufacturing processed yarns and (ii) a yarn processor.

[Background Art]

[0002] Various heaters have been proposed for processing (such as false twisting) of yarns which are formed of synthetic filaments. For example, Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2005-68573) discloses a heater (primary heater in Patent Literature 1) with DOWTHERM (Registered Trademark of Dow Inc.) which is a heating medium. In yarn processing with this heater, a contact plate (contact member) with which a yarn makes contact is heated to a predetermined processing temperature by the heating medium. As the running yarn makes contact with the contact member, the yarn is heated to the processing temperature (in a contact manner). For example, Patent Literature 2 (Japanese Laid-Open Patent Publication No. 2011-47074) discloses a heater (first heater in Patent Literature 2) in which a yarn runs in a yarn running space heated by a sheathed heater which is a heat source. With this arrangement, the yarn is heated by gas in the yarn running space (in a contactless manner). In yarn processing with this heater, the temperature in the yarn running space is set to be higher than the processing temperature above and the running speed of the yarn is appropriately adjusted. As a result, the yarn running in the yarn running space is heated so that the temperature of the yarn is substantially identical with the processing temperature. For example, Patent Literature 3 (Japanese Laid-Open Patent Publication No. 2002-194631) discloses a means for switching a way of heating between the contact manner and the contactless manner in a heater in which a sheathed heater is a heat source.

SUMMARY OF THE INVENTION

[0003] Typically, in a contact manner, it is preferable to set a heating temperature (the set temperature of a contact member) to be low (e.g., 225 degrees centigrade or less in Patent Literature 3). Meanwhile, in a contactless manner, it is preferable to set a heating temperature (the set temperature in a yarn running space) to be high (e.g., 420 degrees centigrade or more in Patent Literature 3). The present inventors have opinions about the reasons of these arrangements. When the heating temperature is within one range (hereinafter, this range will be referred to as the middle range) and a yarn cannot properly run because of yarn breakage, the yarn disadvantageously melts in a heater and adheres to the heater (i.e., results of the fusion). In order to remove the adhered matters, the heater needs to be stopped for a long time. When each set temperature is sufficiently high, the yarn is easily

sublimed at a time of yarn breakage. As a result, the fusion between the yarn and the heater is avoided. Therefore, the heating temperature has been set to be lower than the middle range in the contact manner and to be higher than the middle range in the contactless manner. Meanwhile, a yarn processing method and a yarn processor with a high heating efficiency are required.

[0004] An object of the present invention is to increase, when a yarn is heated and processed in a heater, a heating efficiency while avoiding risk of fusion in yarn breakage.

[Solution to Problem]

[0005] According to a first aspect of the invention, a manufacturing method of processed yarns includes a step of heating a running yarn, which is made of synthetic fibers, by means of a heater, the heater including a heat source and a heating unit which is heated by the heat source, the heating unit including a contact surface extending at least in a predetermined extending direction, the running yarn making contact with the contact surface, the contact surface being oriented at least downward, the heater being provided so that an inclination angle of the contact surface with respect to a horizontal direction is within a range of -60 to 60 degrees in a cross section parallel to both a vertical direction and the extending direction, and the yarn running and making contact with the contact surface, while the temperature of the contact surface is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade.

[0006] According to this aspect, a temperature range of 230 to 350 degrees centigrade is referred to as a middle range. Typically, when a heating temperature of the contact surface is not more than 350 degrees centigrade, there is risk of fusion of the yarn. However, the present inventors considered that it would be possible to further efficiently heat the yarn by, while avoiding the fusion, using a contact manner and setting the heating temperature within the middle range. That is, the heating temperature is able to be set to be higher in this case as compared to cases where a traditional contact manner is used. It is therefore possible to increase a heating efficiency. Even when the heating temperature of the heater is lower than that of a traditional heater with a contactless manner, the yarn is able to be efficiently heated by the contact surface (i.e., it is possible to increase the heating efficiency).

[0007] In this aspect, in a regular state (i.e., state in which the yarn properly runs), even when the temperature (heating temperature) of the contact surface is at the predetermined temperature within the middle range, the yarn is heated to an appropriate processing temperature (i.e., the fusion is avoided) by suitably setting the type, brand (thickness), and running speed of the yarn and the heating temperature. The contact surface is oriented at least downward, and the inclination angle of the contact

surface with respect to the horizontal direction is within the range of -60 to 60 degrees. (The specific definition of the inclination angle will be described later in the embodiment.) With this arrangement, the yarn is able to quickly leave the contact surface by its own weight when yarn breakage occurs. Because of this, the fusion of the yarn is avoided even when the yarn breakage occurs.

[0008] According to a second aspect of the invention, the manufacturing method of the first aspect is arranged such that a material of the yarn is polyester and the predetermined temperature is not less than 250 degrees centigrade and not more than 350 degrees centigrade.

[0009] In regard to polyester, when the heating temperature is not less than 250 degrees centigrade, the fusion is highly likely to occur. This aspect of the invention is especially effective to avoid the fusion at this heating temperature.

[0010] According to a third aspect of the invention, the manufacturing method of the first aspect is arranged such that a material of the yarn is nylon 6 and the predetermined temperature is not less than 230 degrees centigrade and not more than 350 degrees centigrade.

[0011] In regard to nylon 6, when the heating temperature is not less than 230 degrees centigrade, the fusion is highly likely to occur. This aspect of the invention is especially effective to avoid the fusion at this heating temperature.

[0012] According to a fourth aspect of the invention, the manufacturing method of the first aspect is arranged such that a material of the yarn is nylon 66, and the predetermined temperature is not less than 260 degrees centigrade and not more than 350 degrees centigrade.

[0013] In regard to nylon 66, when the heating temperature is not less than 260 degrees centigrade, the fusion is highly likely to occur. This aspect of the invention is especially effective to avoid the fusion at this heating temperature.

[0014] According to a fifth aspect of the invention, the manufacturing method of any one of the first to fourth aspects is arranged such that the predetermined temperature is not more than 320 degrees centigrade.

[0015] When the heating temperature is equal to or close to 350 degrees centigrade, the fusion may be likely to occur in accordance with conditions such as the type and/or thickness of the yarn and the running speed of the yarn. According to this aspect, the fusion is further reliably avoided by setting the heating temperature to be lower than 320 degrees centigrade.

[0016] According to a sixth aspect of the invention, the manufacturing method of any one of the first to the fifth aspects is arranged such that an electric heater is used as the heat source.

[0017] Typically, there are a heat source configured to heat the contact surface by means of a heating medium and a heat source configured to heat the contact surface by means of Joule heat generated by an electric heater. Because the heat source with the heating medium typically has the limit of increase in temperature of the heat-

ing medium, it is difficult to increase the temperature of the contact surface. In this aspect of the invention, it is possible to easily increase the temperature of the contact surface by using the electric heater.

[0018] According to a seventh aspect of the invention, the manufacturing method of the sixth aspect is arranged such that the heater in the extending direction is not less than 0.4 m and not more than 1.6 m in length.

[0019] In this aspect of the invention, it is possible to deal with various yarns by using the heater with an appropriate length in the extending direction in accordance with the conditions such as the type and/or thickness of each yarn and the running speed of each yarn.

[0020] According to an eighth aspect of the invention, a yarn processor includes a heater configured to heat a running yarn made of synthetic fibers, the heater including a heat source, a heating unit which is heated by the heat source, and a controller programmed to control the heat source, the heating unit including a contact surface extending at least in a predetermined extending direction, the running yarn making contact with the contact surface, the contact surface being oriented at least downward, the heater being provided so that an inclination angle of the contact surface with respect to a horizontal direction is within a range of -60 to 60 degrees in a cross section parallel to both a vertical direction and the extending direction, and when the yarn runs while making contact with the contact surface, the controller controlling the heat source so that the temperature of the contact surface is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade.

[0021] In this aspect of the invention, similarly to the first aspect, it is possible to avoid the risk of the fusion when the yarn breakage occurs.

[0022] According to a ninth aspect of the invention, the yarn processor of the eighth aspect is arranged such that a material of the yarn is polyester and the predetermined temperature is not less than 250 degrees centigrade and not more than 350 degrees centigrade.

[0023] In this aspect of the invention, similarly to the second aspect, it is possible to avoid the risk of the fusion in regard to polyester.

[0024] According to a tenth aspect of the invention, the yarn processor of the eighth aspect is arranged such that a material of the yarn is nylon 6 and the predetermined temperature is not less than 230 degrees centigrade and not more than 350 degrees centigrade.

[0025] In this aspect of the invention, similarly to the third aspect, it is possible to avoid the risk of the fusion in regard to nylon 6.

[0026] According to an eleventh aspect of the invention, the yarn processor of the eighth aspect is arranged such that a material of the yarn is nylon 66 and the predetermined temperature is not less than 260 degrees centigrade and not more than 350 degrees centigrade.

[0027] In this aspect of the invention, similarly to the fourth aspect, it is possible to avoid the risk of the fusion

in regard to nylon 66.

[0028] According to a twelfth aspect, the yarn processor of any one of the eighth to eleventh aspects is arranged such that the heat source includes an electric heater.

[0029] In this aspect of the invention, similarly to the sixth aspect, it is possible to easily increase the temperature of the contact surface.

[0030] According to a thirteenth aspect, the yarn processor of the twelfth aspect is arranged such that the heater in the extending direction is not less than 0.4 m and not more than 1.6 m in length.

[0031] In this aspect of the invention, similarly to the seventh aspect, it is possible to deal with various yarns by using the heater with an appropriate length in the extending direction in accordance with the conditions such as the type and/or thickness of each yarn and the running speed of each yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

FIG. 1 is a profile of a false-twist texturing machine configured to embody a manufacturing method of processed yarns in the present embodiment.

FIG. 2 is a schematic diagram of the false-twist texturing machine, expanded along paths of the yarns. Each of FIGs. 3(a) to 3(d) illustrates a first heater. FIG. 4 illustrates how an inclination angle of a contact surface with respect to a horizontal direction is defined.

Each of FIGs. 5(a) and 5(b) illustrates the limit of the inclination angle of the contact surface with respect to the horizontal direction.

FIG. 6 is a graph showing the relationship between crimp contraction and a heating temperature in each of various heaters which false-twist the yarns each having a predetermined thickness.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] The following will describe an embodiment of the present invention. A vertical direction to the sheet of FIG. 1 is defined as a base longitudinal direction, and a left-right direction to the sheet of FIG. 1 is defined as a base width direction. A direction orthogonal to the base longitudinal direction and the base width direction is defined as an up-down direction (vertical direction) in which the gravity acts. In this regard, the base longitudinal direction and the base width direction are substantially in parallel to the horizontal direction.

(Overall Structure of False-Twist Texturing Machine)

[0034] To begin with, the following will describe the overall structure of a false-twist texturing machine 1 (yarn processor of the present invention) configured to embody

a manufacturing method of processed yarns in the present embodiment, with reference to FIG. 1 and FIG. 2. FIG. 1 is a profile of the false-twist texturing machine 1. FIG. 2 is a schematic diagram of the false-twist texturing machine 1, expanded along paths of yarns Y (i.e., yarn paths).

[0035] The false-twist texturing machine 1 is able to false-twist the yarns Y made of synthetic fibers (such as polyester). Each yarn Y is, for example, a multi-filament yarn made of plural filaments. Alternatively, each yarn Y may be made of one filament. The false-twist texturing machine 1 includes a yarn supplying unit 2, a processing unit 3, and a winding unit 4. The yarn supplying unit 2 is able to supply the yarns Y. The processing unit 3 is configured to pull out the yarns Y from the yarn supplying unit 2 and to false-twist the yarns Y. The winding unit 4 is configured to wind the yarns Y which has been processed by the processing unit 3 onto winding bobbins Bw. Components of the yarn supplying unit 2, the processing unit 3, and the winding unit 4 are aligned to form plural lines (see FIG. 2) in the base longitudinal direction. The base longitudinal direction is a direction orthogonal to a yarn running surface (i.e., sheet of FIG. 1) on which yarn paths from the yarn supplying unit 2 to the winding unit 4 through the processing unit 3 are provided.

[0036] The yarn supplying unit 2 includes a creel stand 7 retaining yarn supply packages Ps, and supplies the yarns Y to the processing unit 3. The processing unit 3 is configured to pull out the yarns Y from the yarn supplying unit 2 and to process the yarns Y. In the processing unit 3, for example, the following members are placed in this order from the upstream side in a yarn running direction in which the yarns Y run: first feed rollers 11; twist-stopping guides 12; first heaters 13 (heaters of the present invention); coolers 14; false-twisting devices 15; second feed rollers 16; interlacing devices 17; third feed rollers 18; a second heater 19; and fourth feed rollers 20. The winding unit 4 includes plural winding devices 21. Each winding device 21 winds a corresponding yarn Y which has been false-twisted by the processing unit 3 onto a winding bobbin Bw and forms a wound package Pw.

[0037] The false-twist texturing machine 1 includes a main frame 8 and a winding base 9 that are spaced apart from each other in the base width direction. The main frame 8 and the winding base 9 are substantially identical in length in the base longitudinal direction. The main frame 8 and the winding base 9 oppose each other in the base width direction. The false-twist texturing machine 1 includes units which are termed spans, each of which includes a pair of the main frame 8 and the winding base 9. In one span, each device is placed so that the yarns Y running while being aligned in the base longitudinal direction can be simultaneously false-twisted. In the false-twist texturing machine 1, the spans are placed in a left-right symmetrical manner to the sheet, with a center line C of the base width direction of the main frame 8 being set as a symmetry axis (i.e., main frame 8 is shared

between the left span and the right span). The spans are aligned in the base longitudinal direction.

(Processing Unit)

[0038] The structure of the processing unit 3 will be described with reference to FIG. 1 and FIG. 2. Each first feed roller 11 is configured to unwind one yarn Y from one yarn supply package Ps attached to the yarn supplying unit 2, and to feed the yarn Y to a corresponding first heater 13. As shown in FIG. 2, for example, each first feed roller 11 is configured to feed one yarn Y to a corresponding first heater 13. Alternatively, each first feed roller 11 may be able to feed adjacent yarns Y to the downstream side in the yarn running direction. Each twist-stopping guide 12 is provided to prevent twist of the yarn Y from being propagated to the upstream side of the twist-stopping guide 12 in the yarn running direction. The twist of the yarn Y is formed by a corresponding false-twisting device 15.

[0039] Each first heater 13 is configured to heat the yarns Y supplied from some first feed rollers 11 to a predetermined processing temperature. As shown in FIG. 2, for example, each first heater 13 is able to heat two yarns Y. Each first heater 13 will be detailed later.

[0040] Each cooler 14 is configured to cool one of the yarns Y heated by the first heater 13. As shown in FIG. 2, for example, each cooler 14 is configured to cool one yarn Y. Alternatively, the cooler 14 may be able to simultaneously cool plural yarns Y. Each false-twisting device 15 is provided downstream of a corresponding cooler 14 in the yarn running direction, and configured to twist the yarn Y. Each false-twisting device 15 is, for example, a so-called disc-friction false-twisting device. However, the disclosure is not limited to this. Each second feed roller 16 is configured to feed the yarn Y processed by the false-twisting device 15 to a corresponding interlacing device 17. The conveyance speed of conveying the yarn Y by each second feed roller 16 is higher than the conveyance speed of conveying the yarn Y by each first feed roller 11. With this arrangement, the yarn Y is therefore drawn and false-twisted between each first feed roller 11 and each second feed roller 16.

[0041] Each interlacing device 17 is configured to interlace the yarn Y. Each interlacing device 17 has, for example, a known interlace nozzle configured to interlace the yarn Y by means of an airflow.

[0042] Each third feed roller 18 is configured to feed the yarn Y running downstream of a corresponding interlacing device 17 in the yarn running direction, to the second heater 19. As shown in FIG. 2, for example, each third feed roller 18 is configured to feed one yarn Y to the second heater 19. Alternatively, each third feed roller 18 may be able to feed adjacent yarns Y to the downstream side in the yarn running direction. The conveyance speed of conveying the yarn Y by each third feed roller 18 is lower than the conveyance speed of conveying the yarn Y by each second feed roller 16. The yarn Y is therefore

relaxed between each second feed roller 16 and each third feed roller 18. The second heater 19 is configured to heat the yarns Y fed from some third feed rollers 18. The second heater 19 extends along the vertical direction, and one second heater 19 is provided in one span. Each fourth feed roller 20 is configured to feed one of the yarns Y heated by the second heater 19 to a corresponding winding device 21. As shown in FIG. 2, for example, each fourth feed roller 20 is able to feed one yarn Y to the winding device 21. Alternatively, each fourth feed roller 20 may be able to feed adjacent yarns Y to the downstream side in the yarn running direction. The conveyance speed of conveying the yarn Y by each fourth feed roller 20 is lower than the conveyance speed of conveying the yarn Y by each third feed roller 18. The yarn Y is therefore relaxed between each third feed roller 18 and each fourth feed roller 20.

[0043] In the processing unit 3 structured as above, each of the yarns Y drawn between the first feed rollers 11 and the second feed rollers 16 is twisted by a corresponding false-twisting device 15. The twist formed by the false-twisting device 15 propagates to a corresponding twist-stopping guide 12, but does not propagate to the upstream side of the twist-stopping guide 12 in the yarn running direction. The yarn Y which is twisted and drawn is heated by a corresponding first heater 13 and thermally set. After that, the yarn Y is cooled by a corresponding cooler 14. The yarn Y is untwisted on the downstream side of a corresponding false-twisting device 15 in the yarn running direction. However, the yarn Y is maintained to be wavy in shape on account of the thermal setting described above (i.e., the crimp contraction of the yarn Y is maintained).

[0044] The false-twisted yarn Y is interlaced by a corresponding interlacing device 17 while being relaxed between a corresponding second feed roller 16 and a corresponding third feed roller 18. After that, the yarn Y is guided toward the downstream side in the yarn running direction. Subsequently, the yarn Y is thermally set by the second heater 19 while being relaxed between the third feed roller 18 and a corresponding fourth feed roller 20. Finally, the yarn Y which is fed by the fourth feed roller 20 is wound by a corresponding winding device 21.

(Winding Unit)

[0045] The structure of the winding unit 4 will be described with reference to FIG. 2. The winding unit 4 includes the winding devices 21. Each winding device 21 is able to wind one yarn Y onto one winding bobbin Bw. The winding device 21 includes a fulcrum guide 41, a traverse unit 42, and a cradle 43. The fulcrum guide 41 is a guide which is a fulcrum when the yarn Y is traversed. The traverse unit 42 is able to traverse the yarn Y by means of a traverse guide 45. The cradle 43 is configured to rotatably support the winding bobbin Bw. A contact roller 46 is provided in the vicinity of the cradle 43. The contact roller 46 is configured to apply a contact pressure

by making contact with the surface of one wound package Pw. In the winding unit 4 structured as above, the yarn Y which is fed by the fourth feed roller 20 described above is wound onto the winding bobbin Bw by the winding device 21, and forms the wound package Pw.

(First Heater)

[0046] The specific structure of each first heater 13 will be described with reference to FIGs. 3(a) to 3(d). FIG. 3(a) illustrates one first heater 13 which is viewed in the base longitudinal direction so that a direction in which the first heater 13 extends (extending direction described later) is the left-right direction of the sheet of FIG. 3(a). FIG. 3(b) is a cross section taken along a line Ab-Ab in FIG. 3(a). FIG. 3(c) is a cross section taken along a line Ac-Ac in FIG. 3(b). FIG. 3(d) is a cross section taken along a line Ad-Ad in FIG. 3(b). A direction orthogonal to both the base longitudinal direction and the extending direction is defined as a height direction (see FIG. 3(b)). In each of FIGs. 3(a) to 3(d), the left side of the sheet is defined as one side in the extending direction, and the right side of the sheet is defined as the other side in the extending direction. The one side in the extending direction may be, for example, on the upstream side in the yarn running direction. However, the disclosure is not limited to this. In each of FIGs. 3(a) to 3(d), the upper side of the sheet is defined as one side in the height direction, and the lower side of the sheet is defined as the other side in the height direction.

[0047] The first heater 13 is configured to heat at least one running yarn Y. In the present embodiment, the first heater 13 is able to heat, for example, two yarns Y (yarn Ya and Yb; see FIG. 3(b)). The first heater 13 extends in a predetermined extending direction orthogonal to the base longitudinal direction (see FIG. 3(a), etc.). The length of the first heater 13 in the extending direction is preferably not less than 0.4 m and not more than 1.6 m. Alternatively, the length of the first heater 13 in the extending direction may be, for example, not less than 1.0 m and not more than 1.5 m. The first heater 13 with an appropriate length in the extending direction is preferably selected in accordance with conditions such as the type of the yarns, the thickness of the yarns, and the yarn running speed. The first heater 13 includes a heat source 51 and a heating unit 52. The first heater 13 is configured to simultaneously heat the yarns Ya and Yb by causing the running yarns Ya and Yb to make contact with the heating unit 52 which is heated by the heat source 51.

[0048] The heat source 51 is, for example, a known sheathed heater (electric heater). The sheathed heater includes a heating wire (such as a coil) and a pipe surrounding the heating wire. The sheathed heater is configured to generate Joule heat when an electrical current flows in the heating wire. The heat source 51 extends along the extending direction (see FIGs. 3(a) and 3(c)). The heat source 51 is electrically connected to a controller 100 (see FIG. 3(a); control unit of the present inven-

tion) programmed to control a heating temperature of the first heater 13. The controller 100 is able to set the heating temperature of the first heater 13. The controller 100 is programmed to control the first heater 13 based on a value of the set temperature of the first heater 13. For example, the controller 100 may control the first heater 13 by taking into account: the set temperature of the first heater 13; and a detection result by a temperature sensor (not illustrated) configured to detect an actual temperature of the heating unit 52. The controller 100 may be electrically connected to other devices forming the false-twist texturing machine 1, in addition to the first heater 13.

[0049] The heating unit 52 is configured to be heated by heat generated by the heat source 51. The heating unit 52 extends in the extending direction along the heat source 51 (see FIG. 3(a)). In the extending direction, the heating unit 52 and the first heater 13 are substantially identical in length. For example, when the length of the first heater 13 in the extending direction is 1.0 m, the length of the heating unit 52 is also 1.0 m. The heating unit 52 includes, for example, two heating members 53 (heating members 53a and 53b) and two contacted blocks 54 (contacted blocks 54a and 54b). The heating member 53a and the contacted block 54a are members for heating the yarn Ya. The heating member 53b and the contacted block 54b are members for heating the yarn Yb. The members configured to heat the yarn Ya oppose the members configured to heat the yarn Yb over the heat source 51 in, for example, the base longitudinal direction.

[0050] The following will describe the members configured to heat the yarn Ya. The heating member 53a is made of a metal material such as yellow copper in which the specific heat is high. The heating member 53a extends in the extending direction along the heat source 51. The heating member 53a is provided to be in contact with the heat source 51. For example, the heating member 53a is provided on one side in the base longitudinal direction of the heat source 51 (on the left side of the sheet of FIG. 3(b)). The heating member 53a includes, for example, one (slit 55a) of slits 55 which form yarn paths and extend in the extending direction. The slit 55a is a slit which has an upside-down U shape in a cross section orthogonal to the extending direction. The slit 55a is open to the other side in the height direction. In the slit 55a, one (contacted block 54a) of the contacted blocks 54 is housed.

[0051] The contacted block 54a forms one of the yarn paths for the yarn Ya to run. The contacted block 54a is, for example, a long member made of SUS. The contacted block 54a extends at least in the extending direction. The contacted block 54a is housed in the slit 55a. The contacted block 54a is fixed to the heating member 53a to be in contact with the heating member 53a. The contacted block 54a is heated by the heat which is transmitted from the heat source 51 via the heating member 53a, with the result that the temperature of the contacted block 54a is increased. The contacted block 54a includes one

(contact surface 56a) of contact surfaces 56 with which the yarns Y are caused to make contact. The contact surface 56a is oriented at least to the other side in the height direction. The contact surface 56a is, for example, substantially U-shaped in a cross section orthogonal to the base longitudinal direction (see FIG. 3(d)). The contact surface 56a has, for example, an upside-down U shape when viewed in the extending direction (see FIG. 3(b)).

[0052] The following will describe the members configured to heat the yarn Yb. For example, the heating member 53b is provided on the other side in the base longitudinal direction of the heat source 51 (on the right side of the sheet of FIG. 3(b)). The heating member 53b is in contact with the heat source 51. The heating member 53b includes a slit 55b which is identical in shape with the slit 55a. In the slit 55b, a contacted block 54b which is provided in the same manner as the contacted block 54a is housed. The contacted block 54b includes a contact surface 56b which is identical in shape with the contact surface 56a. The contact surface 56b is oriented at least to the other side in the height direction. The details of the members configured to heat the yarn Yb will be omitted.

[0053] When the yarns Y properly run (hereinafter, this state will be referred to as a regular state), (i) the positional relationship between the first heater 13 and the twist-stopping guide 12 and (ii) the positional relationship between the first heater 13 and the cooler 14 are appropriately arranged so that the yarns Y reliably make contact with the contact surfaces 56. With this arrangement, the force directed toward the contact surfaces 56 side is applied to the yarns Y at least in the height direction. In this regard, the yarns Y run along the respective contact surfaces 56. Therefore, in the regular state, the yarns Y are prevented from leaving the respective contact surfaces 56.

[0054] In the first heater 13 structured as above, the yarns Y make contact with the respective contact surfaces 56 while running in the regular state, so as to be heated by the heating unit 52 via the respective contact surfaces 56 (i.e., the yarns Y are heated in a contact manner). With this arrangement, the yarns Y are heated. The temperature of each yarn Y is increased to an appropriate processing temperature by properly setting the type, brand (thickness), and running speed of the yarn Y and the heating temperature of the first heater 13. The heating temperature of the first heater 13 and the processing temperature are not necessarily identical. The heating temperature of the first heater 13 is typically set to be higher than a target value, i.e., the processing temperature.

[0055] In this regard, the heating temperature of the first heater 13 has been set not to be within one range (hereinafter, this range will be referred to as the middle range). This is because the yarns Y may adhere to the device when (i) the heating temperature of the first heater 13 is set within the middle range and (ii) the yarns Y cannot properly run because of yarn breakage. Mean-

while, recently, a yarn processing method and a yarn processor with a high heating efficiency are required. The first heater 13 is structured as below in order to, when the yarns Y are heated and processed in the heater, increase the heating efficiency while avoiding the risk of fusion in the yarn breakage.

(Structure and Arrangement of First Heater)

[0056] The specific structure of each first heater 13 will be described with reference to FIGs. 3(a) to FIG. 5(b). FIG. 4 illustrates how an inclination angle of each contact surface 56 with respect to the horizontal direction is defined. Each of FIGs. 5(a) and 5(b) illustrates the limit of the inclination angle of the contact surface 56 with respect to the horizontal direction.

[0057] The heating temperature (i.e., set temperature of the contact surface 56) of the first heater 13 is settable at any temperature at least within the middle range (e.g., within a range of 230 to 350 degrees centigrade in the present embodiment). The heating temperature of the first heater 13 may be settable at a temperature lower than 230 degrees centigrade. Furthermore, the heating temperature of the first heater 13 may be settable at a temperature higher than 350 degrees centigrade.

[0058] As described above, each contacted block 54 of the first heater 13 includes a corresponding contact surface 56. As shown in FIGs. 3(b) and 3(d), there is a non-closed space on the other side in the height direction of the contact surface 56 (to be more specific, to the lower side). In this regard, the word "non-closed" means that there is no member below the contact surface 56 in the first heater 13 and there is a space which allows the yarns Y to be drop off from the first heater 13 by their own weight.

[0059] As shown in FIG. 3(d) and FIG. 4, for example, the contact surface 56 has an upside-down U shape in the cross section orthogonal to the base longitudinal direction (i.e., cross section parallel to both the up-down direction and the extending direction). To be more specific, the central portion (a part in the vicinity of a point P0 in FIG. 4) of the contact surface 56 in the extending direction is substantially in parallel to the extending direction. The outer part of each end portion of the contact surface 56 in the extending direction is inclined from the extending direction. The end of the contact surface 56 on the one side in the extending direction (at the point P1 in FIG. 4) and the end of the contact surface 56 on the other side in the extending direction (at the point P2 in FIG. 4) are most inclined from the extending direction as compared to the other part of the contact surface 56. For example, when the first heater 13 is provided so that the extending direction is substantially in parallel to the horizontal direction (see FIG. 4), the part of the contact surface 56 in the vicinity of the point P0 is substantially in parallel to the horizontal direction in a cross section orthogonal to the base longitudinal direction. In this case, the end of the contact surface 56 at the point P1 and the

end of the contact surface 56 at the point P2 are considerably inclined from the horizontal direction.

[0060] As shown in FIG. 4, an inclination angle at the end of the contact surface 56 at the point P1 with respect to the horizontal direction is defined as an angle θ_1 in a cross section orthogonal to the base longitudinal direction. Similarly, in this cross section, an inclination angle at the end of the contact surface 56 at the point P2 with respect to the horizontal direction is defined as an angle θ_2 . Hereinafter, the definition of the angles θ_1 and θ_2 will be detailed. The angle θ_1 is an angle formed in the cross section orthogonal to the base longitudinal direction between (i) a part of a tangent (tangent T1) at the point P1 of the contact surface 56, which is on the one side in the extending direction, and (ii) a linear line L1 which is substantially horizontal along the base width direction. When the tangent T1 is above the linear line L1 (see FIG. 4 and FIG. 5(a)), the angle θ_1 is a positive angle. When the tangent T1 is below the linear line L1 (see FIG. 5(b)), the angle θ_1 is a negative angle. The angle θ_2 is an angle formed in the cross section orthogonal to the base longitudinal direction between (i) a part of a tangent (tangent T2) at the point P2 of the contact surface 56, which is on the one side in the extending direction, and (ii) a linear line L2 which is substantially horizontal along the base width direction. When the tangent T2 is above the linear line L2 (FIG. 5(a)), the angle θ_2 is a positive angle. When the tangent T2 is below the linear line L2 (see FIG. 4 and FIG. 5(b)), the angle θ_2 is a negative angle. In the cross section orthogonal to the base longitudinal direction, each inclination angle of the contact surface 56 with respect to the horizontal direction is within a range between the angle θ_1 and the angle θ_2 in an area between the point P1 and the point P2.

[0061] In the present embodiment, the inclination angle of the contact surface 56 with respect to the horizontal direction is within a range of -60 to 60 degrees. To be more specific, the inclination angle of a part of the contact surface 56 between the point P1 and the point P2 (i.e., of the entire contact surface 56 in the extending direction) with respect to the horizontal direction is within a range of -60 to 60 degrees. In the present embodiment, when the angles θ_1 and θ_2 are within a range of -60 to 60 degrees, the inclination angle of the entire contact surface 56 with respect to the horizontal direction is within a range of -60 to 60 degrees.

[0062] As described above, there is a non-closed space below (immediately below) the contact surface 56 in the first heater 13, and the inclination angle of the contact surface 56 with respect to the horizontal direction is within a predetermined range in the cross section orthogonal to the base longitudinal direction. With this arrangement, when the yarn breakage occurs during operation of the false-twist texturing machine 1, the yarn Y is able to quickly leave the contact surface 56 by its own weight and to drop off from the first heater 13. Therefore, the occurrence of fusion in the yarn breakage is avoidable even when the set temperature of the first heater 13 is a

temperature within the middle range. In the present embodiment, the middle range is a temperature range of 230 to 350 degrees centigrade. This temperature range was avoided before.

(Manufacturing Method of Processed Yarn)

[0063] The following will describe a manufacturing method of processed yarns (to be more specific, this method includes a step of heating each yarn Y by means of the first heater 13) in the present embodiment. In the present embodiment, each contact surface 56 is oriented at least downward in the first heater 13 as described above. Furthermore, each inclination angle of the contact surface 56 with respect to the horizontal direction is within a range of -60 to 60 degrees in a cross section orthogonal to the base longitudinal direction (cross section parallel to both the up-down direction and the extending direction). Furthermore, the temperature of the contact surface 56 (i.e., heating temperature of the first heater 13) is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade. The yarn Y runs in this state while making contact with the contact surface 56. The yarn Y is heated as such. Therefore, even when the yarn breakage occurs because of any problem, the yarn Y is able to quickly leave the contact surface 56. It is therefore possible to avoid the fusion of the yarn Y in the yarn breakage, i.e., the adherence of the yarn Y to the first heater 13 in the yarn breakage.

[0064] The thickness of the yarn Y to be heated may be any thickness. The above-described contact manner is especially effective when the yarn Y to be heated is thick. Even when the thick yarn Y (e.g., yarn Y which is 80dtex or more) is heated, the contact manner makes it possible to reliably transmit the heat to the yarn Y via the contact surface 56. It is therefore possible to evenly heat the yarn Y in its radial direction.

(Comparison With Traditional Manufacturing Method)

[0065] The following will describe the comparison between the manufacturing method of the present embodiment and a traditional manufacturing method, with reference to FIG. 6. The present inventors made the evaluation as below to check whether the yarn quality of yarns which was processed, in the manufacturing method of processed yarns, by the first heater 13 of the present embodiment was the same as that of yarns which was processed not by the first heater 13 but by a traditional heater (not illustrated).

[0066] FIG. 6 is a graph showing the relationship between crimp contraction and a heating temperature in each of three different heaters described later which false-twist yarns Y each having a predetermined thickness. The horizontal axis indicates the heating temperature, and the vertical axis indicates the crimp contraction. FIG. 6 shows the relationship between the crimp

contraction and the heating temperature in regard to each heated yarn Y which is 167dtex (the thickness of 48 filaments). A material of the yarn Y (yarn material) which was evaluated is polyester. As a reference, a melting point of polyester is within a range of 255 to 260 degrees centigrade. Typically, in false twisting, a preferred processing temperature of polyester by the first heater 13 is within a range of approximately 180 to 200 degrees centigrade. The running speed (processing speed) of the yarn Y which was evaluated is 800 m/min. The relationship between the crimp contraction and the heating temperature is able to be adjusted by changing the running speed of the yarn Y (i.e., by changing how long the running yarn Y is heated by the first heater 13).

[0067] The following will describe the three different heaters. The heater of a first type ("SHEATHED HEATER (CONTACT) 1.0 M" in FIG. 6) among the three different heaters has the same structure as the above-described first heater 13. The words "SHEATHED HEATER" indicate the type of a heat source. The word "(CONTACT)" indicates the contact manner. The words "1.0 M" indicate that the length of a heater in the extending direction is 1.0 m. (Hereinafter, these definitions will be used also in heaters of second and third types among the three different heaters.) The relationship between the heating temperature and the crimp contraction in the heater of the first type is indicated by painted circles in FIG. 6. The heater of the second type ("HEATING MEDIUM (CONTACT) 2.0 M" in FIG. 6) among the three different heaters is a known heater to which the contact manner with DOWTHERM is applied. In this regard, DOWTHERM is a known heating medium. That is, the heater of the second type is a so-called Dowtherm heater. The heating temperature of the heater of the second type is substantially identical with an actual processing temperature of the yarn Y. The relationship between the heating temperature and the crimp contraction in the heater of the second type is indicated by painted squares in FIG. 6. The heater of the third type ("SHEATHED HEATER (CONTACTLESS) 1.0 M" in FIG. 6) among the three different heaters has the substantially same structure as the above-described first heater 13. For example, the heater of the third type includes a slit guide described in Japanese Laid-Open Patent Publication No. H9-291428, instead of each contacted block 54 of the first heater 13. The heater of the third type is a known heater to which a contactless manner (i.e., a way of heating the yarn Y mainly by using air which is heated by the heating unit 52) is applied. The relationship between the heating temperature and the crimp contraction in the heater of the third type is indicated by painted triangles in FIG. 6.

[0068] The following briefly describes how the heater (Dowtherm heater) of the second type and the heater (heater with the contactless manner) of the third type are developed. The above-described Dowtherm heater has been widely used. However, because the Dowtherm heater has the limit of increase in heating temperature, when the thickness of the yarn Y to be heated increases,

the size of the Dowtherm heater needs to be increased or the running speed of the yarn Y needs to be decreased. Furthermore, because the Dowtherm heater typically has a large heat radiation portion, the power consumption to retain the heating temperature is disadvantageously large. Thereafter, a heater including a sheathed heater as a heat source has been produced. This makes it possible to easily increase the heating temperature of the heater while reducing the size of the device, and to arrange the heat radiation portion to be small while the increase in power consumption is suppressed. The present inventors consider that the contactless manner needs to be applied to this heater so that (i) the heating temperature of the heater is sufficiently high and (ii) the yarn Y is not heated too much, in order to avoid the above-described fusion.

[0069] When the heating temperature of the above-described heater (i.e., first heater 13 of the present embodiment) of the first type was set to be within a range of approximately 250 to 290 degrees centigrade (indicated by solid lines in FIG. 6), the crimp contraction which was achieved by the heater of the first type was substantially identical with the crimp contraction which was achieved by the above-described heater (i.e., Dowtherm heater) of the second type. In this regard, the heating temperature of the heater of the second type was set to be within a range of approximately 180 to 200 degrees centigrade (indicated by dotted lines in FIG. 6). Furthermore, this crimp contraction which was achieved by the heater of the first type was substantially identical with the crimp contraction which was achieved by the above-described heater (i.e., sheathed heater with the contactless manner) of the third type. In this regard, the heating temperature of the heater of the third type was set to be within a range of approximately 420 to 460 degrees centigrade (indicated by one-dot chain lines in FIG. 6). These evaluation results are comparison results of yarn properties of yarns running in the three different heaters at a particular running speed. These yarns are a particular type of yarns with a particular thickness. In this regard, these evaluation results do not indicate that the heating temperature of the first heater 13 is limited to a range of approximately 250 to 290 degrees centigrade.

[0070] As described above, the yarn quality of yarns which were processed by the heater of the first type was similar to the yarn quality of yarns which were processed by the traditional heater of the second type and that of yarns which were processed by the traditional heater of the third type. In this regard, the heater of the first type has the same structure as the first heater 13. For example, the advantages of using the contact manner and setting the heating temperature of the first heater 13 in the middle range are as follows. Because the heating temperature of the first heater 13 is settable to be higher than that of the heater (Dowtherm heater) of the second type, the size of the device can be reduced and/or the heating efficiency of the first heater 13 can be increased. Furthermore, because the heating temperature of the first

heater 13 is settable to be lower than that of the heater (heater with the contactless manner) of the third type, the power consumption of the heat source 51 can be reduced. Furthermore, because the first heater 13 has the contact surface 56, heat can be effectively transmitted to the yarn Y via the contact surface 56. Therefore, even when the thick yarn Y is heated, the outer part and inner part of the yarn Y in its radial direction are evenly heated.

[0071] As described above, in the regular state, even when the temperature (heating temperature) of each contact surface 56 is within the middle range, a corresponding yarn is heated to an appropriate processing temperature (i.e., fusion is avoided) by suitably setting the type, brand (thickness), and running speed of the yarn and the heating temperature. The contact surface 56 is oriented at least downward, and the inclination angle of the contact surface 56 with respect to the horizontal direction is within a range of -60 to 60 degrees. With this arrangement, the yarn Y is able to quickly leave the contact surface 56 by its own weight when the yarn breakage occurs. Because of this, the fusion of the yarn Y is avoided even when the yarn breakage occurs. It is therefore possible to increase the heating efficiency while avoiding the risk of fusion of the yarn Y in the yarn breakage. Furthermore, it is possible to reduce the size of the device and/or to reduce the power consumption as described above by using the contact manner and setting the heating temperature of the contact surface 56 within the middle range.

[0072] In the present embodiment, the temperature of the contact surface 56 is easily increased to be equal to or higher than a melting point of the yarn material by using the sheathed heater as the heat source 51. In this regard, the sheathed heater is an electric heater.

[0073] The length of the first heater 13 in the extending direction is not less than 0.4 m and not more than 1.6 m. It is possible to deal with various conditions, i.e., various yarns Y each having a particular type and/or thickness or various yarn running speeds by using the first heater 13 with an appropriate length in the extending direction.

[0074] For example, when each false-twisting device 15 is a known PIN-type false-twisting device, the processing speed is 50 to 100 m/min. When the processing speed is low as such, the length of the first heater 13 is preferably small in the extending direction (e.g., 0.4 m). In this regard, when the above-described Dowtherm heater heats the yarn Y at this processing speed, the length of the Dowtherm heater is, for example, within a range of 1.0 to 1.2 m in the extending direction. For another example, when the thick yarn Y, which is used as an industrial material and which is made of nylon 6, nylon 66, or polyester is heated, the length of the first heater 13 is preferably large in the extending direction (e.g., 1.6 m). The processing speed in this state is 600 to 800 m/min. In this regard, when the yarn Y is heated by the above-described Dowtherm heater at this processing speed, the length of the Dowtherm heater is, for example, within a range of 2.0 to 2.5 m in the extending direction.

[0075] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals, and the explanations thereof are not repeated.

(1) In the embodiment above, there is a non-closed space below (immediately below) each contact surface 56 in the first heater 13. However, the disclosure is not limited to this. To an end portion of the first heater 13 on the other side in the height direction, for example, an openable or detachable cover (not illustrated) configured to suppress the outside air from entering into the yarn running space may be provided. In this regard, the yarn Y runs in the yarn running space. The fusion of the yarn Y is avoidable even in this case because the yarn Y is able to quickly leave the contact surface 56 in the yarn breakage.

(2) The yarn material of the yarn Y is not limited to those described above. For example, the yarn material may be nylon 6 or nylon 66.

(3) In the embodiment above, the middle range is a temperature range of 230 to 350 degrees centigrade. However, the disclosure is not limited to this. The lower limit of the middle range may be changed, for example, in accordance with the type of the yarn material and temperatures at each of which the fusion of the yarn material is likely to occur. For example, the fusion of the yarn Y made of polyester may be likely to occur at a temperature which is equal to or higher than approximately 250 degrees centigrade. Therefore, the lower limit of the middle range regarding polyester may be equal to or higher than 250 degrees centigrade. Furthermore, the fusion of the yarn Y made of nylon 6 may be likely to occur at a temperature which is equal to or higher than approximately 230 degrees centigrade. Therefore, the lower limit of the middle range regarding nylon 6 may be equal to or higher than 230 degrees centigrade. For example, the fusion of the yarn Y made of nylon 66 may be likely to occur at a temperature which is equal to or higher than approximately 260 degrees centigrade. Therefore, the lower limit of the middle range regarding nylon 66 may be equal to or higher than 260 degrees centigrade. When the heating temperature of the first heater 13 (the contact surface 56) is equal to or close to 350 degrees centigrade, the fusion of the yarn Y may be likely to occur in accordance with the conditions such as the type and/or thickness of the yarn Y and the running speed of the yarn Y. Because of this, the upper limit of the middle range may be, for example, 320 degrees centigrade. With this arrangement, the fusion of the yarn Y is further reliably avoided. The heating temperature of the first heater 13 (the contact surface 56) may be a predetermined temperature with which the middle range falls within the above-described ranges.

(4) In the embodiment above, each contacted block 54 is provided as a member including the contact surface 56. However, the disclosure is not limited to this. Instead of the contacted block 54, for example, a SUS plate (not illustrated) formed as sheet metal may be housed in the slit 55 (see Japanese Laid-Open Patent Publication No. 2002-194631). The sheet metal has an upside-down U shape when viewed in the extending direction. A contact surface (not illustrated) may be provided at such a SUS plate.

(5) In the embodiment above, the contact surface 56 is curved in a cross section orthogonal to the base longitudinal direction. However, the disclosure is not limited to this. The contact surface 56 may be, for example, substantially linear in a cross section orthogonal to the base longitudinal direction.

(6) In the embodiment above, the contacted block 54 is housed in each slit 55, and the slit 55 is open to the other side in the height direction. However, the disclosure is not limited to this. For example, when viewed in the extending direction, the position of ends of each heating member 53 on the other side in the height direction may be substantially identical with the position of the end portion of the contact surface 56 on the other side in the axial direction. Also in this case, there is a non-closed space below (immediately below) the contact surface 56.

(7) In the embodiment above, the first heater 13 configured to heat the heating unit 52 by means of the sheathed heater is provided in the false-twist texturing machine 1. However, the disclosure is not limited to this. Instead of the first heater 13, the above-described Dowtherm heater may be provided in the false-twist texturing machine 1. For example, when there is a yarn made of the yarn material in which the melting point is low, the Dowtherm heater may embody the above-described processing method (i.e., manufacturing method of processed yarns).

(8) In the embodiment above, the first heater 13 is able to heat two yarns Y. However, the disclosure is not limited to this. The first heater 13 may be able to heat one yarn Y. Alternatively, the first heater 13 may be able to heat three or more yarns Y.

(9) The present invention is applicable to a known false-twist texturing machine (not illustrated) which is differently structured from the false-twist texturing machine 1. For example, the present invention may be applied to a false-twist texturing machine (not illustrated) described in Japanese Laid-Open Patent Publication No. 2009-74219. This false-twist texturing machine is able to combine two yarn, so as to form one yarn. This false-twist texturing machine is able to (i) combine two yarns into one yarn and then wind the one yarn onto a single cradle, and (ii) to simply wind two yarns which are not combined onto a single cradle. The present invention may be applied to such a false-twist texturing machine. Alternatively, in addition to the false-twist texturing ma-

chine, the present invention is applicable to a yarn processor such as a known air texturing machine (not illustrated) configured to process a running yarn (not illustrated).

Claims

1. A manufacturing method of processed yarns comprising a step of heating a running yarn (Y), which is made of synthetic fibers, by means of a heater (13), the heater (13) including a heat source (51) and a heating unit (52) which is heated by the heat source (51), the heating unit (52) including a contact surface (56) extending at least in a predetermined extending direction, the running yarn (Y) making contact with the contact surface (56), the contact surface (56) being oriented at least downward, the heater (13) being provided so that an inclination angle of the contact surface (56) with respect to a horizontal direction is within a range of -60 to 60 degrees in a cross section parallel to both a vertical direction and the extending direction, and the yarn (Y) running and making contact with the contact surface (56), while the temperature of the contact surface (56) is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade.
2. The manufacturing method according to claim 1, wherein, a material of the yarn (Y) is polyester, and the predetermined temperature is not less than 250 degrees centigrade and not more than 350 degrees centigrade.
3. The manufacturing method according to claim 1, wherein, a material of the yarn (Y) is nylon 6, and the predetermined temperature is not less than 230 degrees centigrade and not more than 350 degrees centigrade.
4. The manufacturing method according to claim 1, wherein, a material of the yarn (Y) is nylon 66, and the predetermined temperature is not less than 260 degrees centigrade and not more than 350 degrees centigrade.
5. The manufacturing method according to any one of claims 1 to 4, wherein, the predetermined temperature is not more than 320 degrees centigrade.
6. The manufacturing method according to any one of claims 1 to 5, wherein, an electric heater is used as

the heat source (51).

less than 0.4 m and not more than 1.6 m in length.

7. The manufacturing method according to claim 6, wherein, the heater (13) in the extending direction is not less than 0.4 m and not more than 1.6 m in length. 5

8. A yarn processor (1) comprising a heater (13) configured to heat a running yarn (Y) made of synthetic fibers, 10
 - the heater (13) including a heat source (51), a heating unit (52) which is heated by the heat source (51), and a controller (100) programmed to control the heat source (51),
 - the heating unit (52) including a contact surface (56) extending at least in a predetermined extending direction, the running yarn (Y) making contact with the contact surface (56), 15
 - the contact surface (56) being oriented at least downward, 20
 - the heater (13) being provided so that an inclination angle of the contact surface (56) with respect to a horizontal direction is within a range of -60 to 60 degrees in a cross section parallel to both a vertical direction and the extending direction, and 25
 - when the yarn (Y) runs while making contact with the contact surface (56), the controller (100) controlling the heat source (51) so that the temperature of the contact surface (56) is set at a predetermined temperature which is not less than 230 degrees centigrade and not more than 350 degrees centigrade. 30

9. The yarn processor (1) according to claim 8, wherein, a material of the yarn (Y) is polyester, and the predetermined temperature is not less than 250 degrees centigrade and not more than 350 degrees centigrade. 35

40

10. The yarn processor (1) according to claim 8, wherein, a material of the yarn (Y) is nylon 6, and the predetermined temperature is not less than 230 degrees centigrade and not more than 350 degrees centigrade. 45

50

11. The yarn processor (1) according to claim 8, wherein, a material of the yarn (Y) is nylon 66, and the predetermined temperature is not less than 260 degrees centigrade and not more than 350 degrees centigrade. 50

55

12. The yarn processor (1) according to any one of claims 8 to 11, wherein, the heat source (51) includes an electric heater. 55

13. The yarn processor (1) according to claim 12, wherein, the heater (13) in the extending direction is not

FIG.1

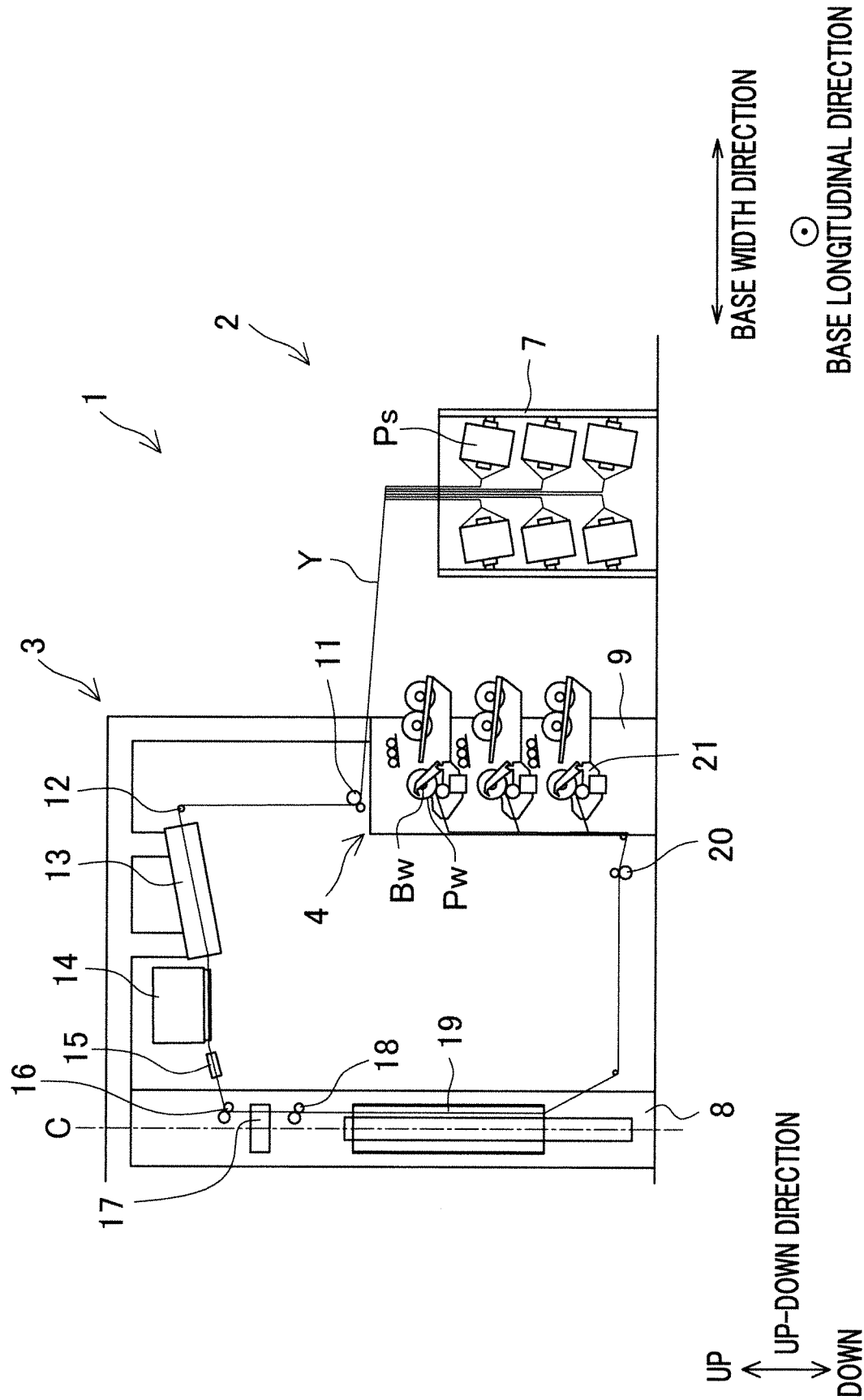
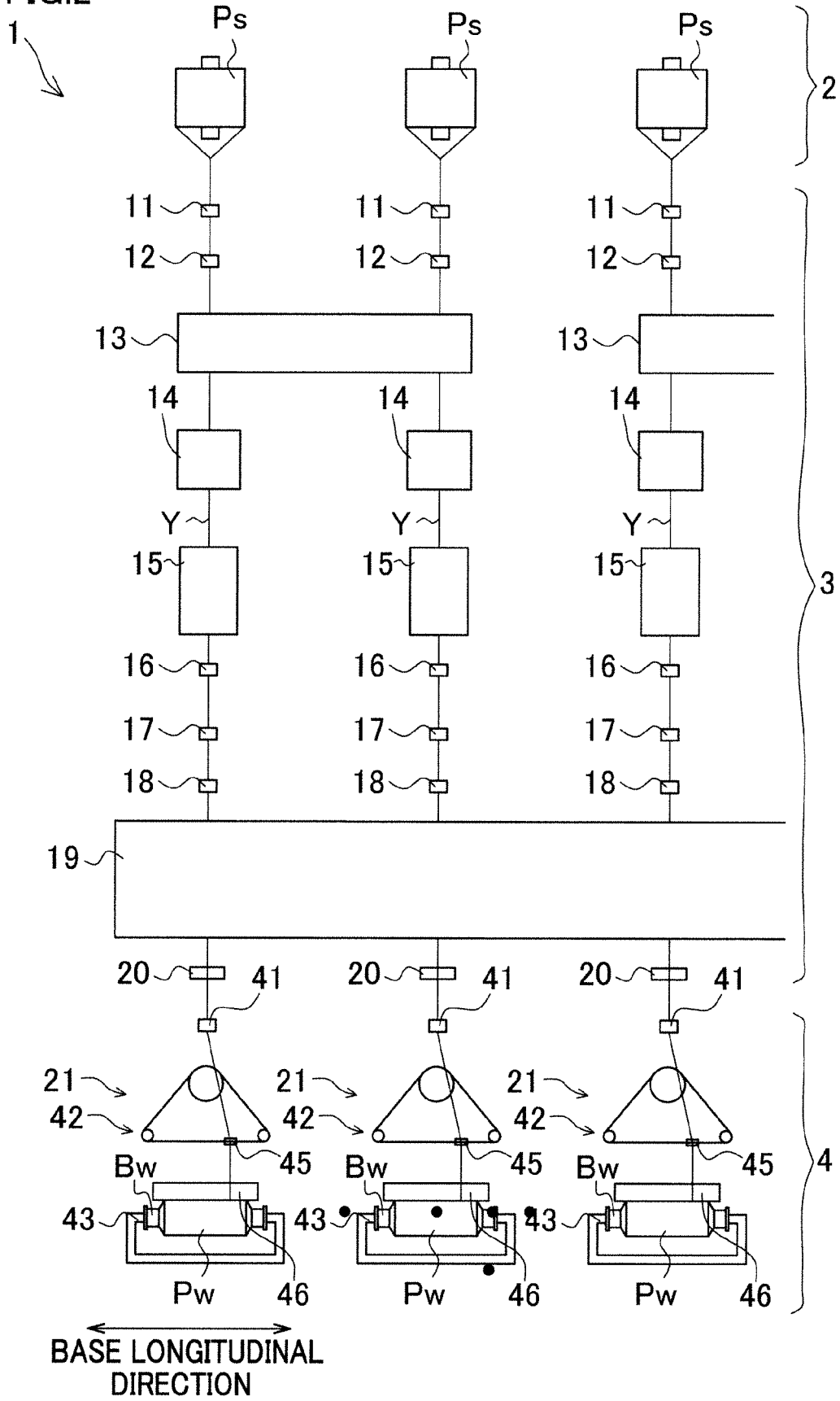


FIG. 2



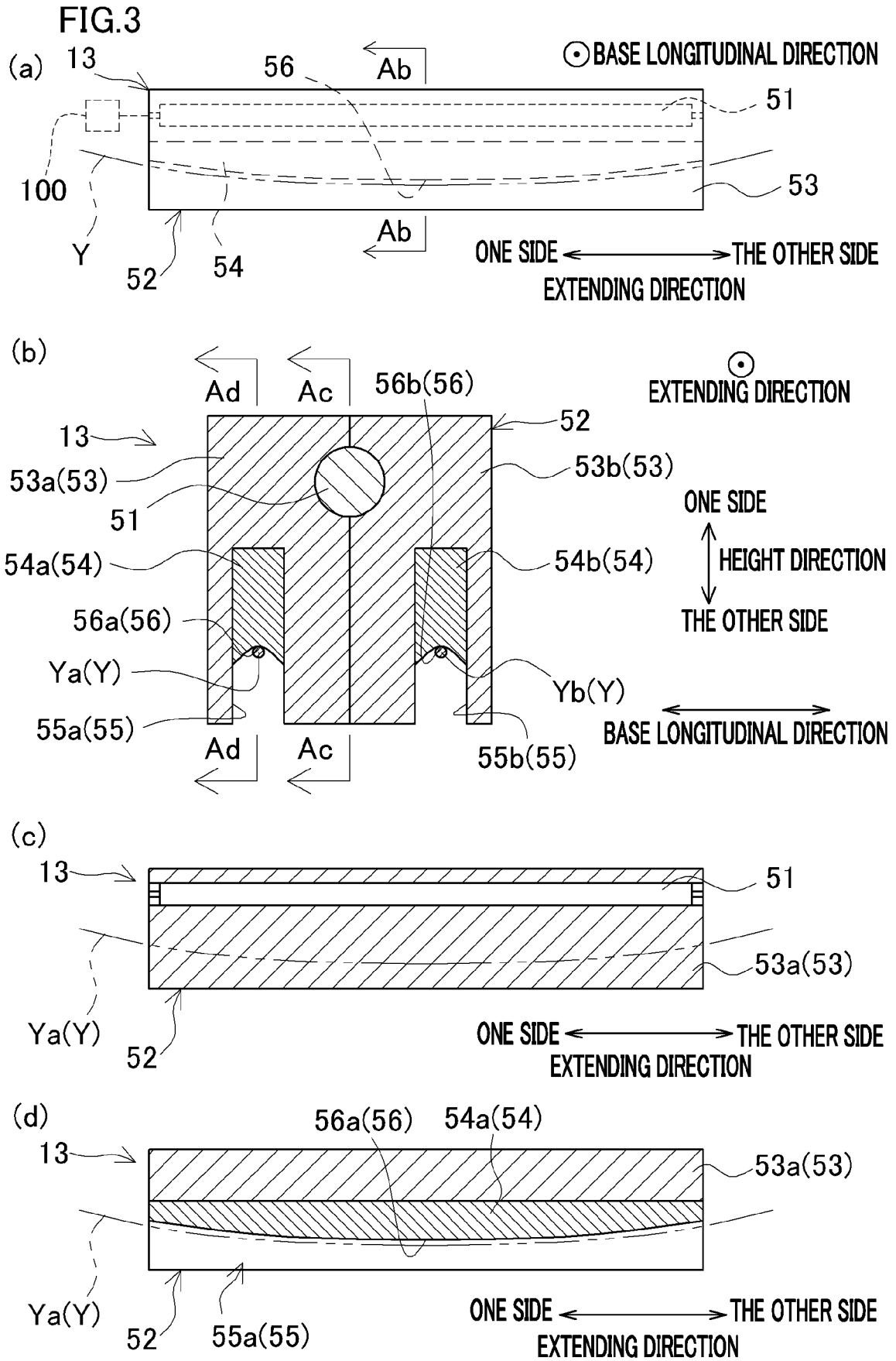


FIG.4

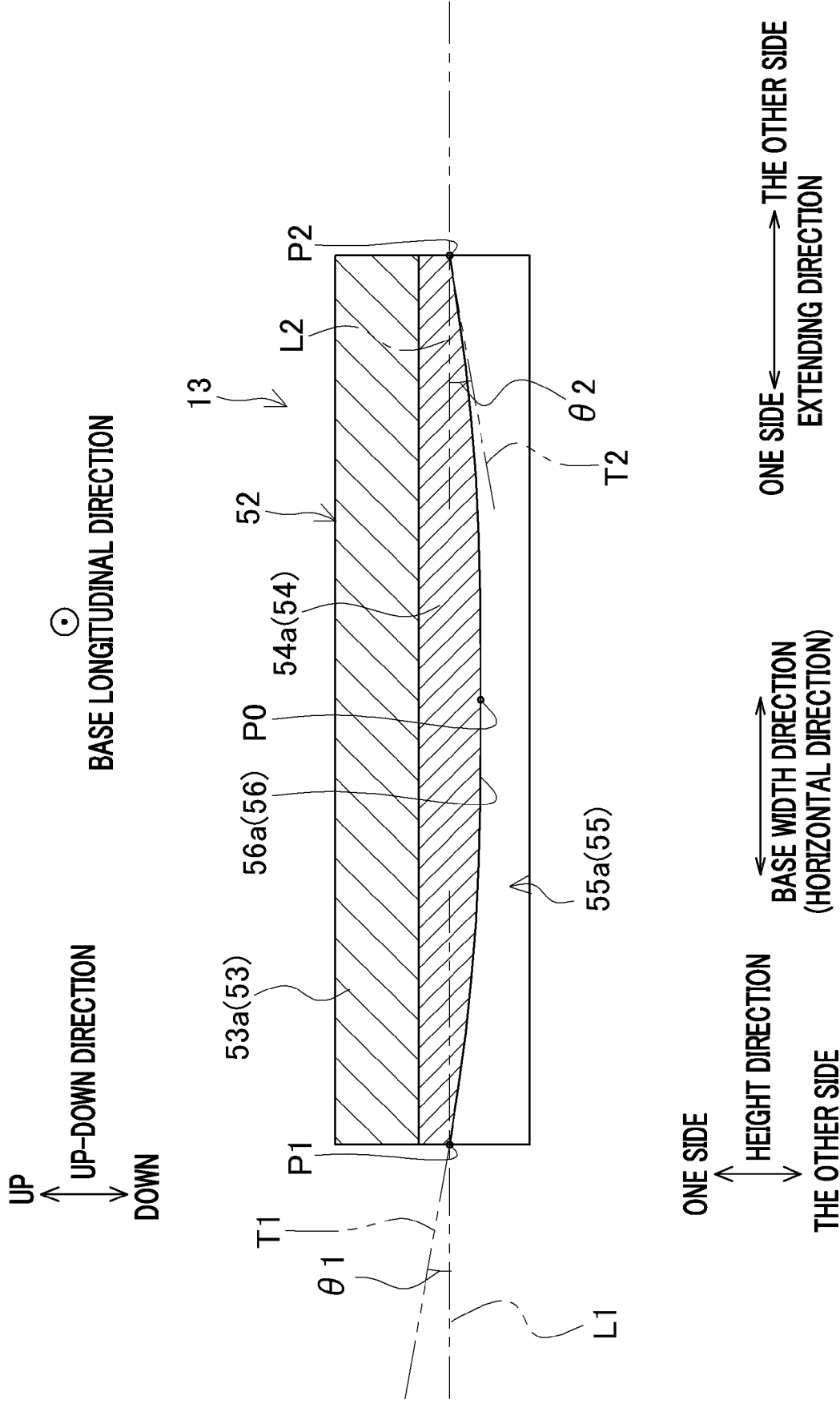


FIG.5

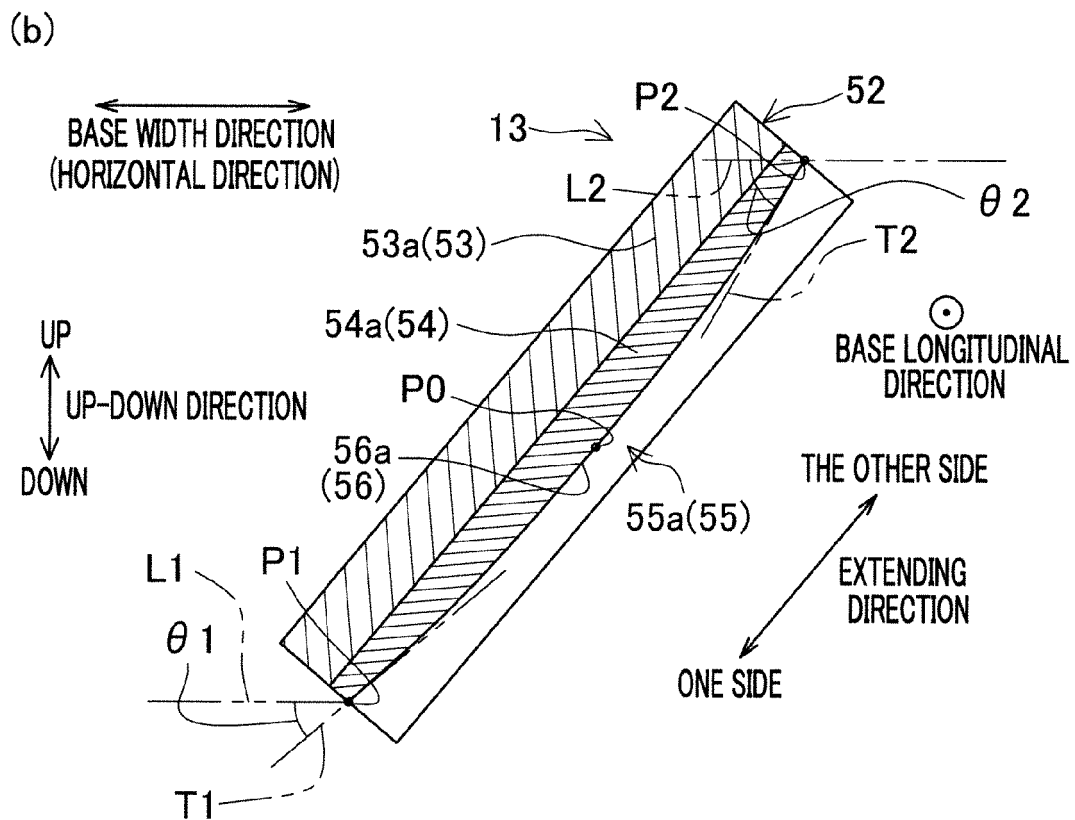
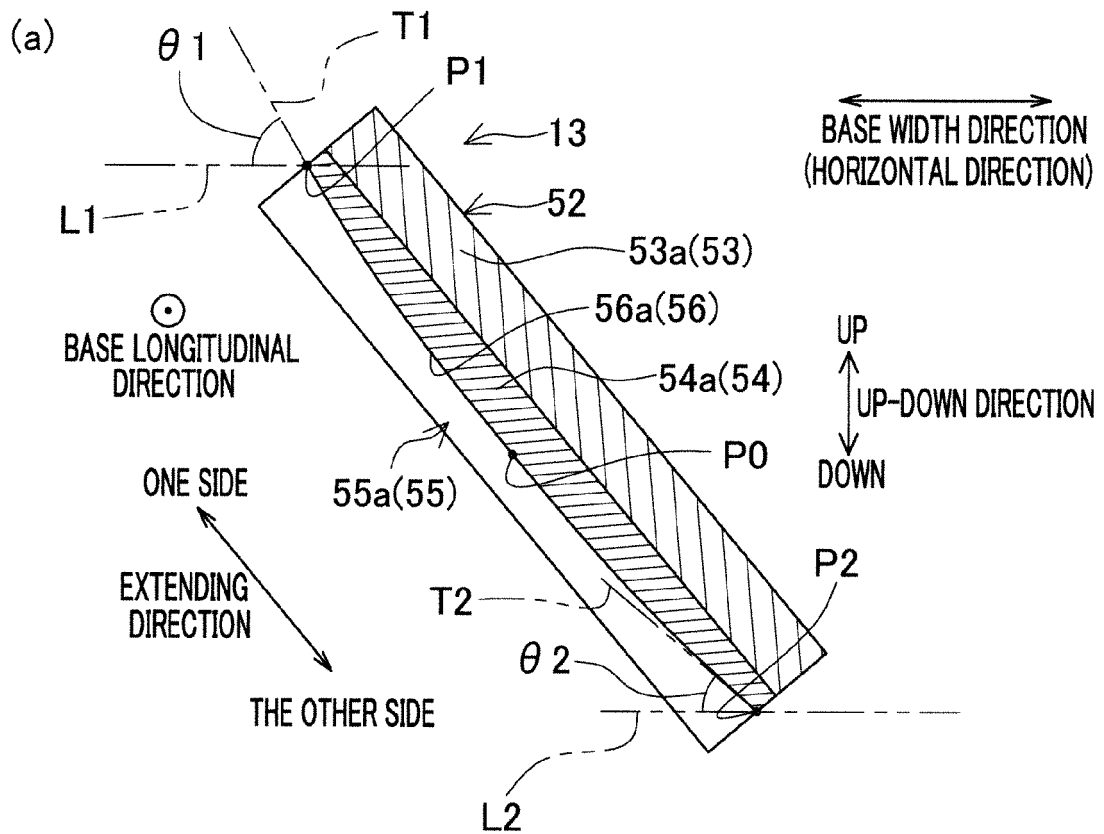
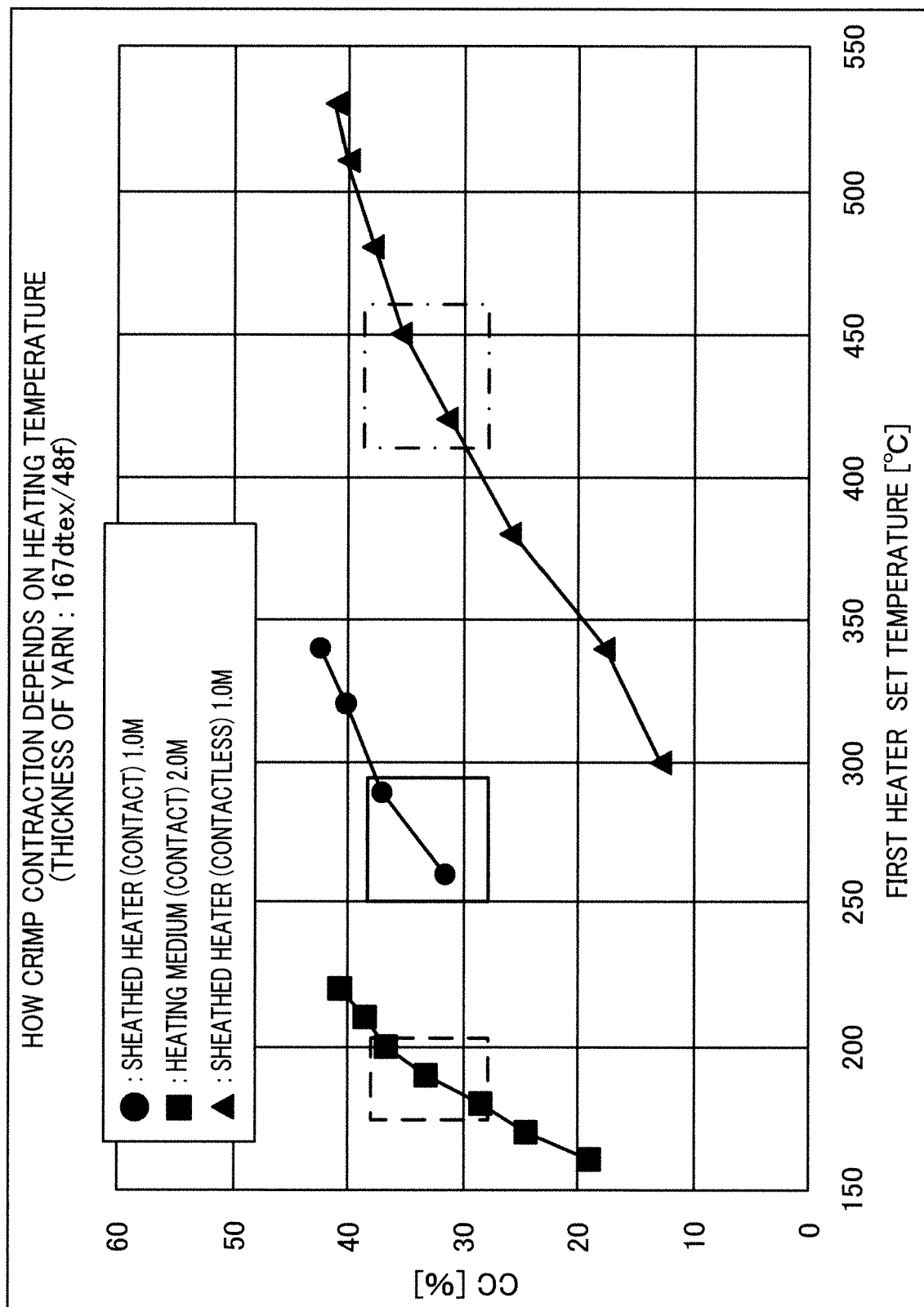


FIG.6





EUROPEAN SEARCH REPORT

Application Number

EP 22 17 5113

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 581 455 A (SCRIVEN ERIC THOMAS) 1 June 1971 (1971-06-01) * figure 8 *	1-13	INV. D02J13/00 D02G1/02
A	JP 2004 100107 A (TOYO DENKI KK) 2 April 2004 (2004-04-02) * abstract; figures 8-10 * * paragraph [0017] *	1-13	
A	EP 0 579 866 A1 (TEIJIN LTD [JP]; TEIJIN SEIKI CO LTD [JP]) 26 January 1994 (1994-01-26) * page 4, line 50 - page 7, line 26 * * page 9, line 2 - page 11, line 45 * * claims; figures 1-3,5 *	1-13	
A	JP 2016 056494 A (TMT MACHINERY INC) 21 April 2016 (2016-04-21) * abstract * * paragraph [0040]; claims; figures 4,11 *	1-13	
A	US 3 879 599 A (KODAIRA NOBUHISA) 22 April 1975 (1975-04-22) * figures 1-3 *	1, 6	TECHNICAL FIELDS SEARCHED (IPC) D02J D02G
A	US 3 770 051 A (KODAIRA N) 6 November 1973 (1973-11-06) * figure 6 *	1, 6	
A	GB 849 607 A (SCRAGG & SONS) 28 September 1960 (1960-09-28) * the whole document *	1, 6	
A	EP 1 435 406 A1 (TOYO ELECTRIC CO LTD [JP]) 7 July 2004 (2004-07-07) * figures 5-8,14 *	1, 6	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 23 November 2022	Examiner Barathe, Rainier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 5113

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2002 020938 A (TEIJIN LTD) 23 January 2002 (2002-01-23) * figure 1b *	1, 6	
A	JP H06 65483 U (MURATA MACHINERY CORPORATION) 16 September 1994 (1994-09-16) * figures 1,2 * * paragraph [0013] *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search The Hague			Date of completion of the search 23 November 2022
			Examiner Barathe, Rainier
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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

EP 22 17 5113

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

23-11-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3581455 A	01-06-1971	BE 727126 A	01-07-1969
		CH 491222 A	31-05-1970
		DE 1902487 A1	13-11-1969
		FR 2000469 A1	05-09-1969
		GB 1251963 A	03-11-1971
		IL 31426 A	28-03-1972
		NL 6900938 A	22-07-1969
		US 3581455 A	01-06-1971

JP 2004100107 A	02-04-2004	JP 3709523 B2	26-10-2005
		JP 2004100107 A	02-04-2004

EP 0579866 A1	26-01-1994	CN 1081724 A	09-02-1994
		CN 1176321 A	18-03-1998
		DE 69226769 T2	28-01-1999
		EP 0579866 A1	26-01-1994
		JP 3164180 B2	08-05-2001
		JP H0649724 A	22-02-1994
		KR 0131446 B1	16-04-1998
		KR 0148214 B1	01-08-1998
		MY 108208 A	30-10-1996
		US 5404705 A	11-04-1995
		US 5528893 A	25-06-1996

JP 2016056494 A	21-04-2016	CN 105401281 A	16-03-2016
		DE 102015216774 A1	10-03-2016
		JP 6535551 B2	26-06-2019
		JP 2016056494 A	21-04-2016
		TW 201610251 A	16-03-2016

US 3879599 A	22-04-1975	NONE	

US 3770051 A	06-11-1973	FR 2176283 A5	26-10-1973
		US 3770051 A	06-11-1973

GB 849607 A	28-09-1960	NONE	

EP 1435406 A1	07-07-2004	CN 1484717 A	24-03-2004
		EP 1435406 A1	07-07-2004
		JP 3569869 B2	29-09-2004
		JP 2003113545 A	18-04-2003
		KR 20040049296 A	11-06-2004
		TW 591142 B	11-06-2004
		US 2004238518 A1	02-12-2004
		WO 03031701 A1	17-04-2003

EPO FORM P0459

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

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

EP 22 17 5113

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

23-11-2022

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002020938 A	23-01-2002	NONE	
JP H0665483 U	16-09-1994	NONE	

15

20

25

30

35

40

45

50

EPO FORM P0459

55

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2005068573 A [0002]
- JP 2011047074 A [0002]
- JP 2002194631 A [0002]
- JP H9291428 A [0067]
- JP 2002 A [0075]
- JP 194631 A [0075]
- JP 2009074219 A [0075]