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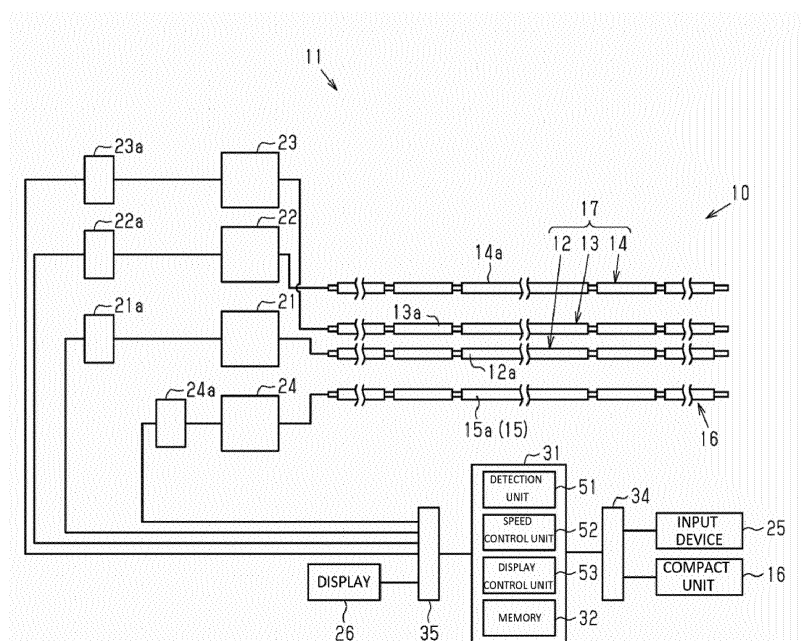
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(54) **DRAFT RATIO SETTING DEVICE FOR SPINNING MACHINE AND THE SPINNING MACHINE**

(57) A draft ratio setting device (31) for a spinning machine (10) includes a drafting device (11) that includes a drafting unit (17) formed of a middle roller (13a), a back roller (14a), and a front roller (12a) and a compact unit (16) that includes a delivery roller (15a) and is attached downstream of the front roller (12a), wherein the compact unit (16) is configured to change a tension draft ratio of

the delivery roller (15a) to the front roller (12a). The draft ratio setting device (31) includes a speed control unit (52) configured to control rotational speeds of the front roller (12a), the middle roller (13a), the back roller (14a), and the delivery roller (15a), and a detection unit (51) configured to detect whether the compact unit (16) is attached to or detached from the drafting device (11).

FIG. 2



Description

BACKGROUND ART

[0001] The present invention relates to a draft ratio setting device for a spinning machine and the spinning machine.

[0002] For example, a draft mechanism for a spinning machine, which has a detachable stretch breaking unit as a compact device, is disclosed in Japanese Patent Publication Application No. H11-241234. The draft mechanism in the Publication includes four bottom rollers. Three bottom rollers of the four bottom rollers are supported by the same supporting portion. The other one bottom roller of the four bottom rollers forms the stretch breaking unit. Thus, the stretch breaking unit is formed such that the stretch breaking unit is attached to or detached from the three bottom rollers.

[0003] When the stretch breaking unit is attached, a fed sliver is drafted by passing through three roller pairs. Furthermore, the sliver is drafted by passing through a roller pair in the stretch breaking unit. When the stretch breaking unit is detached, the three roller pairs are each moved in a delivering direction of the sliver in order to suppress deterioration of yarn quality. This makes a delivering length of the sliver in this state the same as that in a state where the stretch breaking unit is attached.

[0004] When a rotational speed of the bottom roller in the stretch breaking unit is different from a rotational speed of a bottom roller just behind the bottom roller in the stretch breaking unit in the delivering direction of the sliver, a total draft ratio in the drafting mechanism and the number of twisting turns of yarn may be changed before and after the stretch breaking unit is attached.

SUMMARY

[0005] In accordance with an aspect of the present invention, there is provided a draft ratio setting device for a spinning machine that includes a drafting device that includes a drafting unit formed of a middle roller, a back roller, and a front roller being driven independently of the middle roller and the back roller and a compact unit that includes a delivery roller driven independently of the front roller and is attached downstream of the front roller, wherein the compact unit is configured to change a tension draft ratio of the delivery roller to the front roller. The draft ratio setting device includes a speed control unit configured to control rotational speeds of the front roller, the middle roller, the back roller, and the delivery roller, and a detection unit configured to detect whether the compact unit is attached to or detached from the drafting device. When the detection unit detects that the compact unit is attached to the drafting device, the speed control unit controls the rotational speed of the delivery roller so that the rotational speed of the delivery roller is changed to the rotational speed of the front roller before the compact unit is attached to the drafting device and controls

the rotational speed of the front roller so that the rotational speed of the front roller is changed in accordance with a change of the tension draft ratio. When the detection unit detects that the compact unit is detached from the drafting device, the speed control unit controls the rotational speed of the front roller so that the rotational speed of the front roller is changed to the rotational speed of the delivery roller while the compact unit is attached to the drafting device.

[0006] In accordance with another aspect of the present invention, there is provided a spinning machine that includes a drafting device including a drafting unit formed of a middle roller, a back roller, and a front roller being driven independently of the middle roller and the back roller, a compact unit attached downstream of the front roller and including a delivery roller driven independently of the front roller, the compact unit being configured to change a tension draft ratio of the delivery roller to the front roller, and a draft ratio setting device including a speed control unit configured to control rotational speeds of the front roller, the middle roller, the back roller, and the delivery roller, and a detection unit detecting whether the compact unit is attached to or detached from the drafting device. When the detection unit detects that the compact unit is attached to the drafting device, the speed control unit controls the rotational speed of the delivery roller so that the rotational speed of the delivery roller is changed to the rotational speed of the front roller before the compact unit is attached to the drafting device and controls the rotational speed of the front roller so that the rotational speed of the front roller is changed in accordance with a change of the tension draft ratio. When the detection unit detects that the compact unit is detached from the drafting device, the speed control unit controls the rotational speed of the front roller so that the rotational speed of the front roller is changed to the rotational speed of the delivery roller while the compact unit is attached to the drafting device.

[0007] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 is a schematic view illustrating a drafting unit before a compact unit is attached to the drafting unit in an embodiment according to the present invention; FIG. 2 is a schematic view illustrating the drafting unit to which the compact unit is attached; FIG. 3 is a cross-sectional view illustrating the drafting unit before the compact unit is attached to the drafting unit;

FIG. 4 is a cross-sectional view illustrating the drafting unit to which the compact unit is attached;
 FIG. 5 is a table showing a relationship between draft ratios and rotational speeds; and
 FIG. 6 is a table showing a relationship between draft ratios and rotational speeds in another example.

DETAILED DESCRIPTION OF THE INVENTION

[0009] The following will describe an embodiment of a draft ratio setting device for a spinning machine and the spinning machine with reference to FIGS. 1 to 5.

<Spinning machine>

[0010] As illustrated in FIGS. 1 and 2, a spinning machine 10 includes a drafting device 11 and a controller 31 as a draft ratio setting device. In addition, as illustrated in FIGS. 3 and 4, the spinning machine 10 includes a spindle driving unit 40 and a lift operation driving unit which is not illustrated.

<Spindle driving unit>

[0011] The spindle driving unit 40 winds up a yarn drafted by the drafting device 11. The spindle driving unit 40 includes a spindle 41 that rotates a bobbin 42 on which the drafted yarn is wound and a spindle motor 43 that rotates the spindle 41.

<Draft device>

[0012] As illustrated in FIGS. 1 and 2, the drafting device 11 may be a three-line type system including a drafting unit 17 formed of a front roller pair 12, a middle roller pair 13, and a back roller pair 14 or a four-line type system including a delivery roller pair 15 in addition to these roller pairs.

[0013] As illustrated in FIGS. 1 and 3, in the drafting unit 17, the front roller pair 12 includes a front bottom roller 12a and a front top roller 12b. In the drafting unit 17, the middle roller pair 13 includes a middle bottom roller 13a, a middle top roller 13b, and middle aprons 13c. In the drafting unit 17, the back roller pair 14 includes a back bottom roller 14a and a back top roller 14b.

[0014] As illustrated in FIGS. 2 and 4, the delivery roller pair 15 includes a delivery bottom roller 15a, a delivery top roller 15b, and delivery aprons 15c. A compact unit 16 is formed of the delivery bottom roller 15a, the delivery top roller 15b, the delivery aprons 15c, a suction pipe 18, and a guide member 19. The compact unit 16 is attached downstream of the front bottom roller 12a and the front top roller 12b in a delivering direction of a yarn.

[0015] As illustrated in FIGS. 1 and 2, the front bottom roller 12a is driven by a front roller driving motor 21. The middle bottom roller 13a is driven by a middle roller driving motor 22. The back bottom roller 14a is driven by a back roller driving motor 23. The delivery bottom roller

15a is driven by a delivery roller driving motor 24. Thus, the bottom rollers 12a, 13a, 14a, 15a are driven independently of one another. The front bottom roller 12a is driven independently of the middle bottom roller 13a and the back bottom roller 14a in the drafting unit 17. The compact unit 16 is attached downstream of the front bottom roller 12a and includes the delivery bottom roller 15a driven independently of the front bottom roller 12a.

[0016] A servomotor is used as the driving motors 21, 22, 23, 24. The driving motors 21, 22, 23, 24 are connected to drivers 21a, 22a, 23a, 24a, respectively. The controller 31 controls the drivers 21a, 22a, 23a, 24a to drive the driving motors 21, 22, 23, 24, respectively.

[0017] In the drafting device 11, a rotational speed ratio of the middle bottom roller 13a to the back bottom roller 14a is defined as a brake draft ratio. A rotational speed ratio of the front bottom roller 12a to the middle bottom roller 13a is defined as a main draft ratio. A rotational speed ratio of the delivery bottom roller 15a to the front bottom roller 12a is defined as a tension draft ratio. In the drafting device 11 including the compact unit 16, the tension draft ratio is changeable by changing the rotational speed ratio of the delivery roller driving motor 24 to the front roller driving motor 21.

[0018] In the drafting device 11 from which the compact unit 16 is detached, a total draft ratio of the whole of the drafting device 11 is determined by the brake draft ratio and the main draft ratio. Then, in order to obtain a normal yarn of a desired spun yarn count and the desired number of twisting turns, the brake draft ratio and the main draft ratio are set together with the total draft ratio and the rotational speed of the front bottom roller 12a. Accordingly, in the drafting device 11 from which the compact unit 16 is detached, a roving is drafted to produce the normal yarn. As long as the total draft ratio is not changed, the brake draft ratio and the main draft ratio may be adjusted as appropriate. In addition, a rotational speed of the spindle 41 in the spindle driving unit 40 is set. The driver, which is not illustrated, controls the driving of the spindle motor 43, which controls the rotational speed of the spindle 41.

[0019] On the other hand, in the drafting device 11 to which the compact unit 16 is attached, the total draft ratio of the whole of the drafting device 11 is determined from the brake draft ratio, the main draft ratio, and the tension draft ratio. In order to obtain a compact yarn of a desired spun yarn count and the desired number of twisting turns, the brake draft ratio, the main draft ratio, and the tension draft ratio are set together with the total draft ratio and a rotational speed of the delivery bottom roller 15a. Accordingly, in the drafting device 11 to which the compact unit 16 is attached, a roving is drafted to produce the compact yarn. As long as the total draft ratio is not changed, the brake draft ratio, the main draft ratio, and the tension draft ratio may be adjusted as appropriate. In addition, the rotational speed of the spindle 41 in the spindle driving unit 40 is set.

[0020] The above-described drafting device 11 is con-

figured to draft the roving to produce the normal yarn when the compact unit 16 is detached from the drafting device 11. In such a drafting for producing the normal yarn, the total draft ratio suitable for the drafting is set, and the brake draft ratio and the main draft ratio for obtaining the total draft ratio are set.

[0021] In addition, the drafting device 11 is configured to draft the roving to produce the compact yarn when the compact unit 16 is attached to the drafting device 11. The spun yarn count of the compact yarn is larger than that of the normal yarn. That is, the compact yarn is superior to the normal yarn in yarn quality.

[0022] In the drafting for producing the compact yarn, the total draft ratio suitable for the drafting, and the brake draft ratio, the main draft ratio, and the tension draft ratio for obtaining the total draft ratio are set.

<Controller>

[0023] The controller 31 includes a memory 32, a detection unit 51, a speed control unit 52, and a display control unit 53.

[0024] Examples of the controller 31 include a CPU (Central Processing Unit), a GPU (Graphics Processing Unit), and a DSP (Digital Signal Processor). The memory 32 includes a RAM (Random Access Memory) and a ROM (Read Only Memory). The memory 32 stores program codes or commands configured to cause the controller 31 to execute processes. The memory 32, that is, a computer readable medium, includes any available medium that is accessible by a general-purpose computer or a dedicated computer. The controller 31 may include a hardware circuit such as an ASIC (Application Specific Integrated Circuit) or an FPGA (Field Programmable Gate Array). The controller 31, which is a processing circuit, may include one or more processors for operating in accordance with computer programs, one or more hardware circuits such as the ASIC or the FPGA, or a combination thereof.

[0025] The controller 31 is electrically connected to an input device 25 through an input interface 34. An operator performs various setting operations using the input device 25. Examples of the input device 25 include a physical icon, a dial, a keyboard, and a touch pen.

[0026] The controller 31 is electrically connected to the compact unit 16 through the input interface 34.

[0027] The controller 31 is electrically connected to the drivers 21a, 22a, 23a through an output interface 35 and a motor driving circuit which is not illustrated. The controller 31 is also electrically connected to the driver 24a through the output interface 35 and the motor driving circuit which is not illustrated. The controller 31 is electrically connected to a display 26 through the output interface 35. The display 26 is a liquid crystal display or the like. Various pieces of setting information of the drafting device 11, such as the presence or absence of the compact unit 16, the spun yarn count, the number of twisting turns, and various draft ratios are displayed on the display 26.

[0028] The speed control unit 52 controls the rotational speeds of the front bottom roller 12a, the middle bottom roller 13a, the back bottom roller 14a, and the delivery bottom roller 15a.

5 **[0029]** The controller 31 controls a motor that drives the lift operation driving unit and also controls the spindle motor 43 in the spindle driving unit 40. An illustration of the motor that drives the lift operation driving unit is omitted.

10 **[0030]** The detection unit 51 detects whether the compact unit 16 is electrically connected to or disconnected from the input interface 34 based on information manually input from the input device 25. When the detection unit 51 detects that the compact unit 16 is electrically connected to the input interface 34 based on the information manually input from the input device 25, the detection unit 51 outputs a connection detection signal to the speed control unit 52. When the detection unit 51 detects that the compact unit 16 is electrically disconnected from the input interface 34 based on the information manually input from the input device 25, the detection unit 51 outputs a disconnection detection signal to the speed control unit 52.

25 **[0031]** When the compact unit 16 is electrically connected to the input interface 34 and the connection detection signal is input into the speed control unit 52, the speed control unit 52 sets the rotational speed of the delivery roller driving motor 24 to the rotational speed of the front roller driving motor 21 before the compact unit 16 is attached to the drafting device 11. That is, when the detection unit 51 detects that the compact unit 16 is attached, the speed control unit 52 controls the rotational speed of the delivery bottom roller 15a so that the rotational speed of the delivery bottom roller 15a is changed to the rotational speed of the front bottom roller 12a before the compact unit 16 is attached to the drafting device 11. Thus, the delivery roller pair 15 serves as a final delivery roller pair in the drafting device 11 after the compact unit 16 is attached, which has the same rotational speed as that of a final delivery roller pair in the drafting device 11 before the compact unit 16 is attached.

35 **[0032]** On the other hand, in the drafting device 11, the tension draft ratio needs to be considered because of the addition of the delivery roller pair 15 to the drafting device 11. Here, in a case where the tension draft ratio is "1" or "about 1", even when the delivery roller pair 15 is added to the drafting device 11, the total draft ratio is not changed before and after the compact unit 16 is attached.

40 **[0033]** However, in a case where the tension draft ratio is set to a value except for "1", the rotational speed of the front bottom roller 12a before the compact unit 16 is attached is different from the rotational speed of the delivery bottom roller 15a. Thus, when no operation is taken, the total draft ratio in the drafting device 11 changes from the total draft ratio before the compact unit 16 is attached.

55 **[0034]** When the tension draft ratio is set to the value except for "1", the speed control unit 52 changes the main draft ratio in order to make the total draft ratio after the

compact unit 16 is attached the same as that before the compact unit 16 is attached. That is, in order to make the total draft ratio of the drafting device 11 the same as that before the compact unit 16 is attached, the speed control unit 52 controls the rotational speed of the front bottom roller 12a so that the rotational speed of the front bottom roller 12a is changed in accordance with the change of the tension draft ratio to a value except for "1". The speed control unit 52 changes the main draft ratio to compensate for an amount of change in the total draft ratio caused by considering the tension draft ratio. That is, the speed control unit 52 controls the rotational speed of the front bottom roller 12a, thereby canceling out the amount of the change of the total draft ratio. The speed control unit 52 controls the rotational speed of the front bottom roller 12a by the control of the driver 21a of the front roller driving motor 21. Then, the rotational speed of the delivery roller driving motor 24 and the rotational speed of the front bottom roller 12a, which have been set by the speed control unit 52, are temporarily stored in the memory 32. Accordingly, when the detection unit 51 detects that the compact unit 16 is attached to the drafting device 11, the speed control unit 52 changes the main draft ratio of the drafting device 11 while keeping the brake draft ratio of the drafting device 11 the same as that before the compact unit 16 is attached to the drafting device 11.

[0035] Also, in the drafting device 11 including the compact unit 16, the tension draft ratio may be changed. Even in this case, the speed control unit 52 controls the rotational speed of the front bottom roller 12a in order to keep the total draft ratio constant, that is, in order not to change the total draft ratio. Note that the rotational speed of the delivery bottom roller 15a, the rotational speed of the middle bottom roller 13a, and the rotational speed of the back bottom roller 14a are constant because they are not changed.

[0036] In the table of FIG. 5, the tension draft ratio, the rotational speed of the front bottom roller 12a, and the main draft ratio before the tension draft ratio is changed are each defined as a "reference". Note that the front bottom roller 12a is described as a front roller in FIG. 5. Furthermore, in FIG. 5, the middle bottom roller 13a is described as a middle roller, the back bottom roller 14a is described as a back roller, and the delivery bottom roller 15a is described as a delivery roller.

[0037] When the tension draft ratio is increased, in order to keep the total draft ratio, the main draft ratio is decreased by setting the rotational speed of the front bottom roller 12a to be lower than that before the tension draft ratio is changed.

[0038] On the contrary, when the tension draft ratio is decreased, in order to keep the total draft ratio, the main draft ratio is increased by setting the rotational speed of the front bottom roller 12a to be higher than that before the tension draft ratio is changed. That is, when the tension draft ratio is changed, the speed control unit 52 controls the rotational speed of the front bottom roller 12a so that the rotational speed of the front bottom roller 12a

is changed in accordance with the change of the tension draft ratio while keeping the total draft ratio before and after the change of the tension draft ratio.

[0039] The rotational speed of the front bottom roller 12a set in this way is temporarily stored in the memory 32.

[0040] When the spinning machine 10 is operated, the speed control unit 52 obtains the rotational speed stored in the memory 32 and outputs the rotational speed to the driver 21a. Then, the front roller driving motor 21 is controlled by the driver 21a so as to be driven at the rotational speed set by the speed control unit 52. Note that the rotational speed of the middle bottom roller 13a and the rotational speed of the back bottom roller 14a are kept.

[0041] When the detection unit 51 detects that the compact unit 16 is electrically disconnected from the input interface 34 based on the information manually input from the input device 25, the detection unit 51 outputs a disconnection detection signal to the speed control unit 52. In response to the disconnection detection signal, the speed control unit 52 sets the rotational speed of the front roller driving motor 21 to the rotational speed of the delivery roller driving motor 24 while the compact unit 16 is attached to the drafting device 11. That is, when the detection unit 51 detects that the compact unit 16 is detached, the speed control unit 52 controls the rotational speed of the front bottom roller 12a so that the rotational speed of the front bottom roller 12a is changed to the rotational speed of the delivery bottom roller 15a while the compact unit 16 is attached. Thus, the front roller pair 12 serves as the final delivery roller pair in the drafting device 11 after the compact unit 16 is detached, which has the same rotational speed as that of the final delivery roller pair in the drafting device 11 while the compact unit 16 is attached. Then, the rotational speed of the front bottom roller 12a set by the speed control unit 52 is temporarily stored in the memory 32. At the same time, the total draft ratio is changed to the total draft ratio while the compact unit 16 is attached.

[0042] When the spinning machine 10 starts to operate in the state where the compact unit 16 is attached to or detached from the drafting device 11, the speed control unit 52 obtains the rotational speed stored in the memory 32 and outputs the rotational speed to the driver 21a. Then, the front roller driving motor 21 is controlled by the driver 21a so that the front roller driving motor 21 is driven at the rotational speed set by the speed control unit 52.

[0043] Also, the tension draft ratio may be changed in the state where the compact unit 16 is attached to the drafting device 11. Here, when the changed tension draft ratio is input from the input device 25 to the speed control unit 52, the speed control unit 52 changes the rotational speed of the front roller driving motor 21. The main draft ratio is changed by the change of the rotational speed of the front roller driving motor 21 so that the total draft ratio is kept even when the tension draft ratio is changed. For example, when the tension draft ratio is increased, the main draft ratio is decreased so that the total draft ratio is kept. In order to decrease the main draft ratio, the

rotational speed of the front bottom roller 12a is decreased from the rotational speed of the front bottom roller 12a before the tension draft ratio is changed.

[0044] On the contrary, when the tension draft ratio is decreased, the main draft ratio is increased so that the total draft ratio is kept. In order to increase the main draft ratio, the rotational speed of the front bottom roller 12a is increased from the rotational speed of the front bottom roller 12a before the tension draft ratio is changed.

[0045] When the compact unit 16 is electrically connected to the input interface 34, the display control unit 53 causes information that the compact unit 16 is attached to be displayed on the display 26. Furthermore, when the compact unit 16 is electrically disconnected from the input interface 34, the display control unit 53 causes information that the compact unit 16 is detached to be displayed on the display 26.

<Drafting to produce the normal yarn>

[0046] Spinning conditions such as a fiber raw material, and the spun yarn count and the number of twisting turns in the normal yarn are input to the control unit 31 using the input device 25, prior to the operation of the spinning machine 10. When the spinning machine 10 starts to operate, based on commands from the controller 31, the driving motors 21, 22, 23 are controlled through the drivers 21a, 22a, 23a to rotate at the rotational speeds for obtaining the total draft ratio, the main draft ratio, and the brake draft ratio set in advance in correspondence with the spinning conditions. The spindle motor 43 in the spindle driving unit 40 and the driving motor in a lifting operation system are also controlled to rotate at predetermined rotational speeds.

[0047] Then, the roving is drafted by passing through the back roller pair 14, the middle roller pair 13, and the front roller pair 12 of the drafting device 11. After the roving is delivered from the front roller pair 12 as the final delivery roller pair to become the normal yarn, the normal yarn is wound around the bobbin 42 rotating integrally with the spindle 41 in the spindle driving unit 40. Thus, the normal yarn having the spun yarn count, the number of twisting turns, or the like set in advance is manufactured.

<Drafting to produce the compact yarn>

[0048] When the compact yarn is produced by the drafting, spinning conditions such as a fiber raw material, the spun yarn count, and the number of twisting turns are the same as those in the normal yarn.

[0049] The compact unit 16 is mechanically attached to the drafting device 11 prior to the operation of the spinning machine 10, so that the drafting device 11 includes the compact unit 16. When the detection unit 51 detects that the compact unit 16 is electrically connected to the input interface 34 based on the information manually input from the input device 25, the detection unit 51 outputs

the connection detection signal to the speed control unit 52. In response to the connection detection signal, the speed control unit 52 sets the rotational speed of the delivery roller driving motor 24 to be the same as the rotational speed of the front roller driving motor 21 before the compact unit 16 is attached.

[0050] When the spinning machine 10 starts to operate, based on the commands from the controller 31, the driving motors 21, 22, 23, 24 are controlled through the drivers 21a, 22a, 23a, 24a to rotate at the rotational speeds for obtaining the tension draft ratio, the total draft ratio, the main draft ratio, and the brake draft ratio set in advance in correspondence with the spinning conditions. The spindle motor 43 of the spindle driving unit 40 and the driving motor in the lifting operation system are also controlled to rotate at the predetermined rotational speeds.

[0051] Then, the roving is drafted by passing through the back roller pair 14, the middle roller pair 13, the front roller pair 12, and the delivery roller pair 15 of the drafting device 11. After the roving is delivered from the delivery roller pair 15 as the final delivery roller pair to become the compact yarn, the compact yarn is wound around the bobbin 42 rotating integrally with the spindle 41 in the spindle driving unit 40. Thus, the compact yarn having the spun yarn count, the number of twisting turns, or the like set in advance is manufactured.

[0052] The above-described embodiment provides the following effects.

(1) When a kind of yarn produced by drafting the roving using the drafting device 11 is changed from the normal yarn to the compact yarn, the speed control unit 52 sets the rotational speed of the delivery bottom roller 15a to the rotational speed of the front bottom roller 12a before the compact unit 16 is attached to the drafting device 11. With this setting, the delivery bottom roller 15a serves as the final delivery roller, which has the same rotational speed as that of the final delivery roller before the compact unit 16 is attached. In addition, even when the tension draft ratio is changed by attaching the compact unit 16, the speed control unit 52 changes the rotational speed of the front bottom roller 12a. This prevents the total draft ratio and the number of twisting turns of the drafted compact yarn from changing from those before the compact unit 16 is attached even when the tension draft ratio is changed by attaching the compact unit 16.

(2) When a kind of yarn produced by drafting the roving using the drafting device 11 is changed from the compact yarn to the normal yarn, the speed control unit 52 sets the rotational speed of the front bottom roller 12a to the rotational speed of the delivery bottom roller 15a. With this setting, the front bottom roller 12a serves as the final delivery roller, which has the same rotational speed as that of the final

delivery roller while the compact unit 16 is attached. Then, the compact unit 16 is detached from the drafting device, which causes the total draft ratio to return to that before the compact unit 16 is attached. Accordingly, even when the compact unit 16 is detached, the total draft ratio and the number of twisting turns of the drafted normal yarn is prevented from changing after the compact unit 16 is detached.

(3) When the compact unit 16 is electrically connected and the connection detection signal is input to the controller 31, the speed control unit 52 changes the main draft ratio while the brake draft ratio is kept. The brake draft ratio is a factor that largely affects yarn quality. Accordingly, it is possible to change from the normal yarn to the compact yarn while the yarn quality is kept.

(4) When the tension draft ratio is changed in the drafting for producing the compact yarn, the speed control unit 52 changes the rotational speed of the front bottom roller 12a while the rotational speed of the delivery bottom roller 15a is kept. Thus, the compact yarn is produced by the drafting while the total draft ratio and the number of twisting turns are kept.

(5) When the detection unit 51 detects that the compact unit 16 is attached to or detached from the drafting device 11, the speed control unit 52 controls the rotational speeds of the front bottom roller 12a and the delivery bottom roller 15a. Thus, the kind of yarn produced by the drafting is easily switched between the normal yarn and the compact yarn by attaching or detaching the compact unit 16.

[0053] The present embodiment may be modified as described below. The present embodiment and the following modification may be combined with each other as long as they do not technically contradict each other.

[0054] In the case where the tension draft ratio is changed by changing the rotational speed of the front bottom roller 12a while the compact unit 16 is attached to the drafting device 11, the speed control unit 52 may change the rotational speed of the middle roller driving motor 22. In this case, as illustrated in FIG. 6, the brake draft ratio is changed so that the total draft ratio is kept even when the tension draft ratio is changed. Note that the front bottom roller 12a is described as a front roller in FIG. 6. Furthermore, in FIG. 6, the middle bottom roller 13a is described as a middle roller, the back bottom roller 14a is described as a back roller, and the delivery bottom roller 15a is described as a delivery roller.

[0055] For example, when the tension draft ratio is increased, the brake draft ratio is decreased so that the total draft ratio is kept. In order to decrease the brake draft ratio, the rotational speed of the middle bottom roller 13a is decreased from that before the tension draft ratio is changed.

[0056] On the contrary, when the tension draft ratio is decreased, the brake draft ratio is increased so that the total draft ratio is kept. In order to increase the brake draft ratio, the rotational speed of the middle bottom roller 13a is increased from that before the tension draft ratio is changed.

[0057] With this control, when the rotational speed of the front bottom roller 12a is changed in order to change the tension draft ratio, a yarn is most suitably drafted between the front roller pair 12 and the middle roller pair 13.

[0058] When the detection unit 51 detects that the compact unit 16 is attached to the drafting device 11, the speed control unit 52 may change the brake draft ratio of the drafting device 11 while keeping the main draft ratio of the drafting device 11 the same as that before the compact unit 16 is attached. With this control, a yarn is most suitably drafted between the front roller pair 12 and the middle roller pair 13.

[0059] When the kind of yarn produced by drafting the roving is changed from the normal yarn to the compact yarn, the speed control unit 52 may change both the main draft ratio and the brake draft ratio in order not to change the total draft ratio. In this case, the speed control unit 52 adjusts the rotational speeds of the front bottom roller 12a and the middle bottom roller 13a.

[0060] The attachment or detachment of the compact unit 16 to or from the drafting device 11 may be detected by a detection unit such as a sensor that detects the presence or absence of the compact unit 16 or a detection unit that detects that the delivery roller driving motor 24 or a motor for a suction device is electrically connected.

[0061] The attachment or detachment of the compact unit 16 to or from the drafting device 11 does not need to be displayed on the display 26.

[0062] The rollers driven by the driving motors 21, 22, 23, 24 may be the top rollers 12b, 13b, 14b, 15b, respectively.

[0063] The middle roller pair 13 and the back roller pair 14 do not need to be driven independently of each other. A draft ratio setting device (31) for a spinning machine (10) includes a drafting device (11) that includes a drafting unit (17) formed of a middle roller (13a), a back roller (14a), and a front roller (12a) and a compact unit (16) that includes a delivery roller (15a) and is attached downstream of the front roller (12a), wherein the compact unit (16) is configured to change a tension draft ratio of the delivery roller (15a) to the front roller (12a). The draft ratio setting device (31) includes a speed control unit (52) configured to control rotational speeds of the front roller (12a), the middle roller (13a), the back roller (14a), and the delivery roller (15a), and a detection unit (51) configured to detect whether the compact unit (16) is attached to or detached from the drafting device (11).

Claims

1. A draft ratio setting device (31) for a spinning machine (10) including a drafting device (11) that includes a drafting unit (17) formed of a middle roller (13a), a back roller (14a), and a front roller (12a) being driven independently of the middle roller (13a) and the back roller (14a) and a compact unit (16) that includes a delivery roller (15a) driven independently of the front roller (12a) and is attached downstream of the front roller (12a), wherein the compact unit (16) is configured to change a tension draft ratio of the delivery roller (15a) to the front roller (12a), the draft ratio setting device (31) comprising:

a speed control unit (52) configured to control rotational speeds of the front roller (12a), the middle roller (13a), the back roller (14a), and the delivery roller (15a); and

a detection unit (51) configured to detect whether the compact unit (16) is attached to or detached from the drafting device (11), **characterized in that**

when the detection unit (51) detects that the compact unit (16) is attached to the drafting device (11), the speed control unit (52) controls the rotational speed of the delivery roller (15a) so that the rotational speed of the delivery roller (15a) is changed to the rotational speed of the front roller (12a) before the compact unit (16) is attached to the drafting device (11) and controls the rotational speed of the front roller (12a) so that the rotational speed of the front roller (12a) is changed in accordance with a change of the tension draft ratio, and

when the detection unit (51) detects that the compact unit (16) is detached from the drafting device (11), the speed control unit (52) controls the rotational speed of the front roller (12a) so that the rotational speed of the front roller (12a) is changed to the rotational speed of the delivery roller (15a) while the compact unit (16) is attached to the drafting device (11).

2. The draft ratio setting device (31) for the spinning machine (10) according to claim 1, **characterized in that**

when the detection unit (51) detects that the compact unit (16) is attached to the drafting device (11), the speed control unit (52) changes a main draft ratio of the drafting unit (17) while keeping a brake draft ratio of the drafting unit (17) the same as the brake draft ratio before the compact unit (16) is attached to the drafting device (11).

3. The draft ratio setting device (31) for the spinning machine (10) according to claim 1, **characterized in that**

when the detection unit (51) detects that the compact unit (16) is attached to the drafting device (11), the speed control unit (52) changes a brake draft ratio of the drafting unit (17) while keeping a main draft ratio of the drafting unit (17) the same as the main draft ratio before the compact unit (16) is attached to the drafting device (11).

4. The draft ratio setting device (31) for the spinning machine (10) according to any one of claims 1 to 3, **characterized in that**

when the tension draft ratio is changed, the speed control unit (52) controls the rotational speed of the front roller (12a) so that the rotational speed of the front roller (12a) is changed in accordance with the change of the tension draft ratio while keeping a total draft ratio of the drafting device (11) before and after the change of the tension draft ratio.

5. A spinning machine (10) comprising:

a drafting device (11) including a drafting unit (17) formed of a middle roller (13a), a back roller (14a), and a front roller (12a) being driven independently of the middle roller (13a) and the back roller (12a);

a compact unit (16) attached downstream of the front roller (12a) and including a delivery roller (15a) driven independently of the front roller (12a), the compact unit (16) being configured to change a tension draft ratio of the delivery roller (15a) to the front roller (12a); and

a draft ratio setting device (31) including

a speed control unit (52) configured to control rotational speeds of the front roller (12a), the middle roller (13a), the back roller (14a), and the delivery roller (15a), and

a detection unit (51) detecting whether the compact unit (16) is attached to or detached from the drafting device (11), **characterized in that**

when the detection unit (51) detects that the compact unit (16) is attached to the drafting device (11), the speed control unit (52) controls the rotational speed of the delivery roller (15a) so that the rotational speed of the delivery roller (15a) is changed to the rotational speed of the front roller (12a) before the compact unit (16) is attached to the drafting device (11) and controls the rotational speed of the front roller (12a) so that the rotational speed of the front roller (12a) is changed in accordance with a change of the tension draft ratio, and

when the detection unit (51) detects that the compact unit (16) is detached from the drafting device (11), the speed control unit (52) controls

the rotational speed of the front roller (12a) so that the rotational speed of the front roller (12a) is changed to the rotational speed of the delivery roller (15a) while the compact unit (16) is attached to the drafting device (11).

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FIG. 1

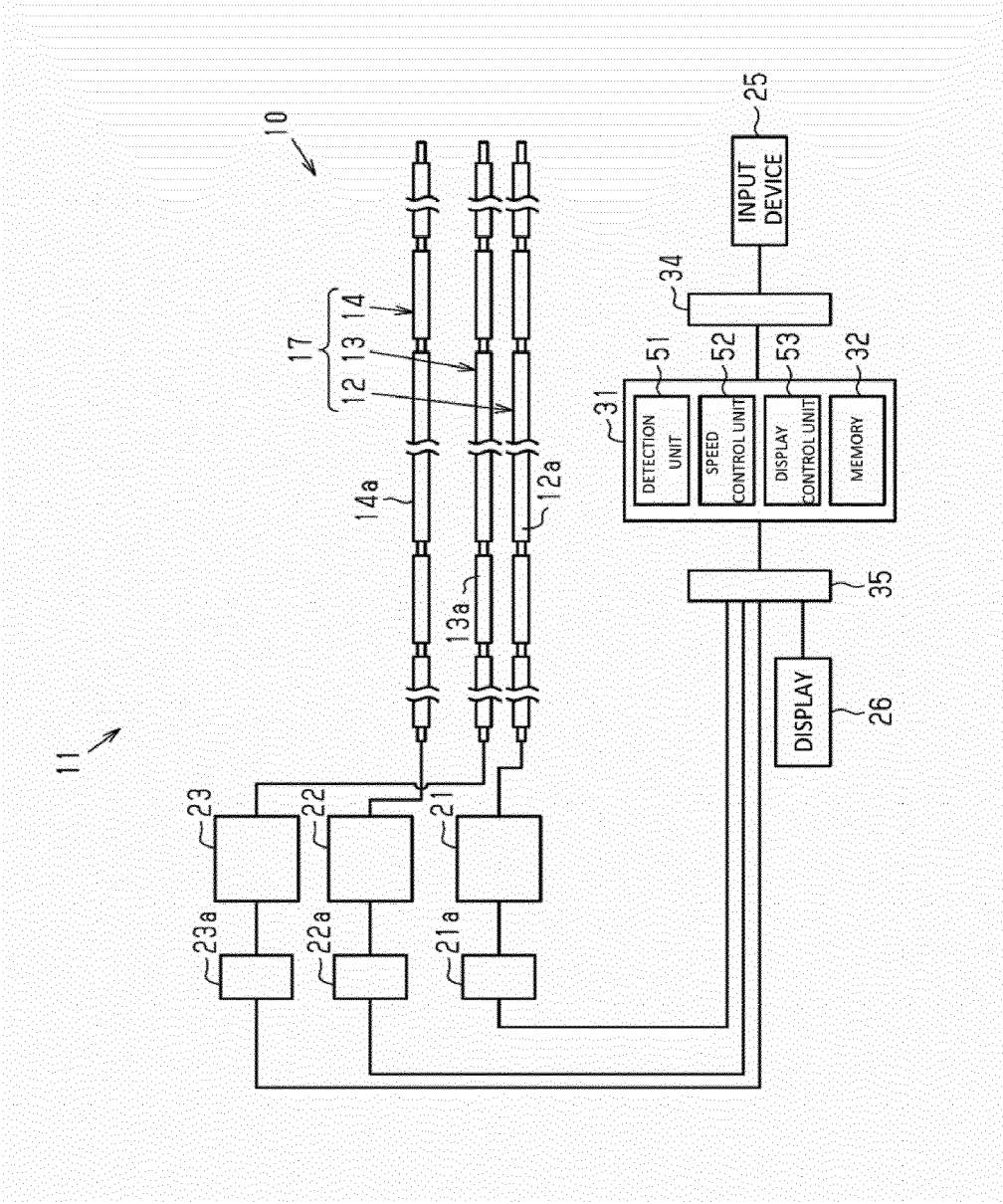


FIG. 2

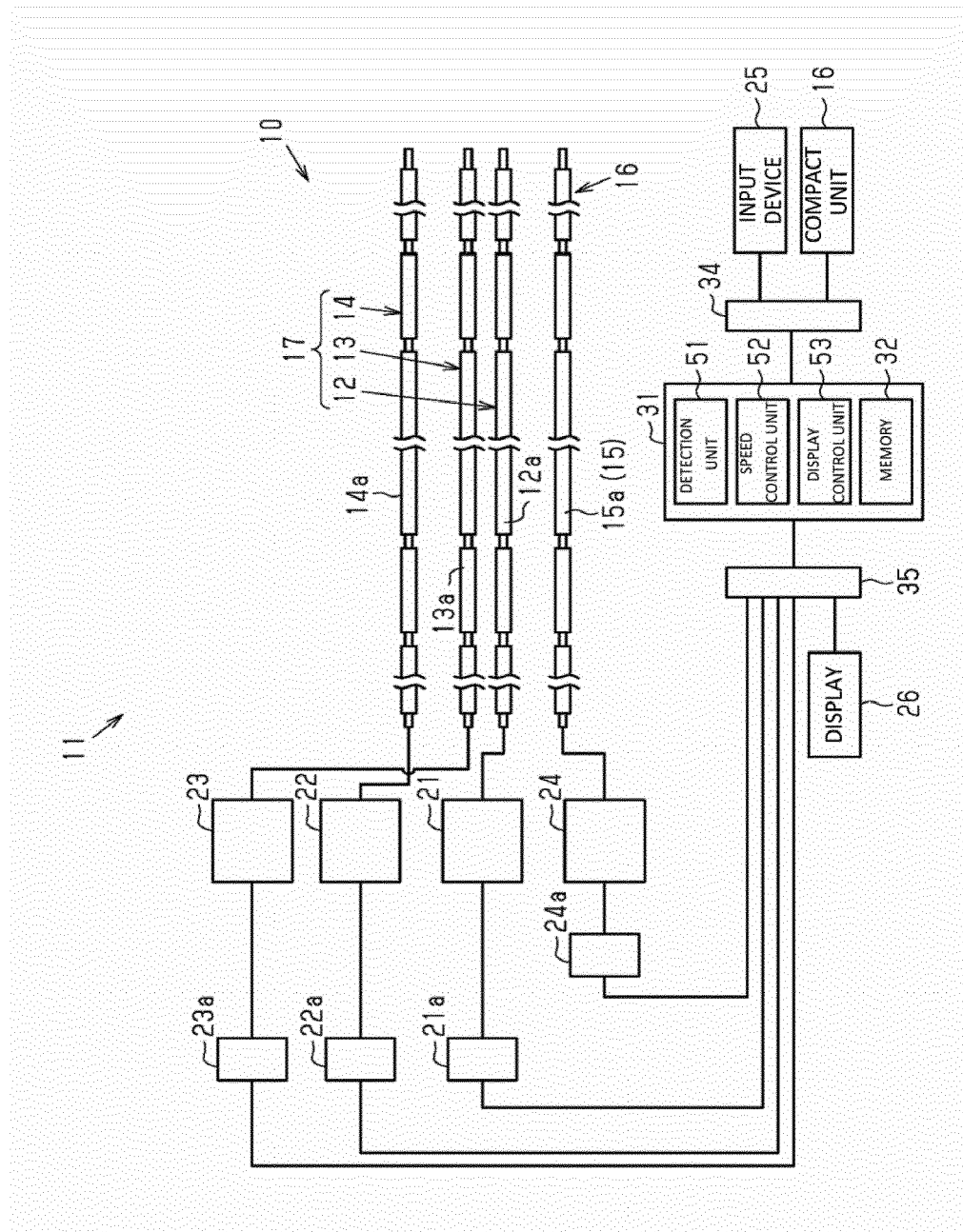


FIG. 3

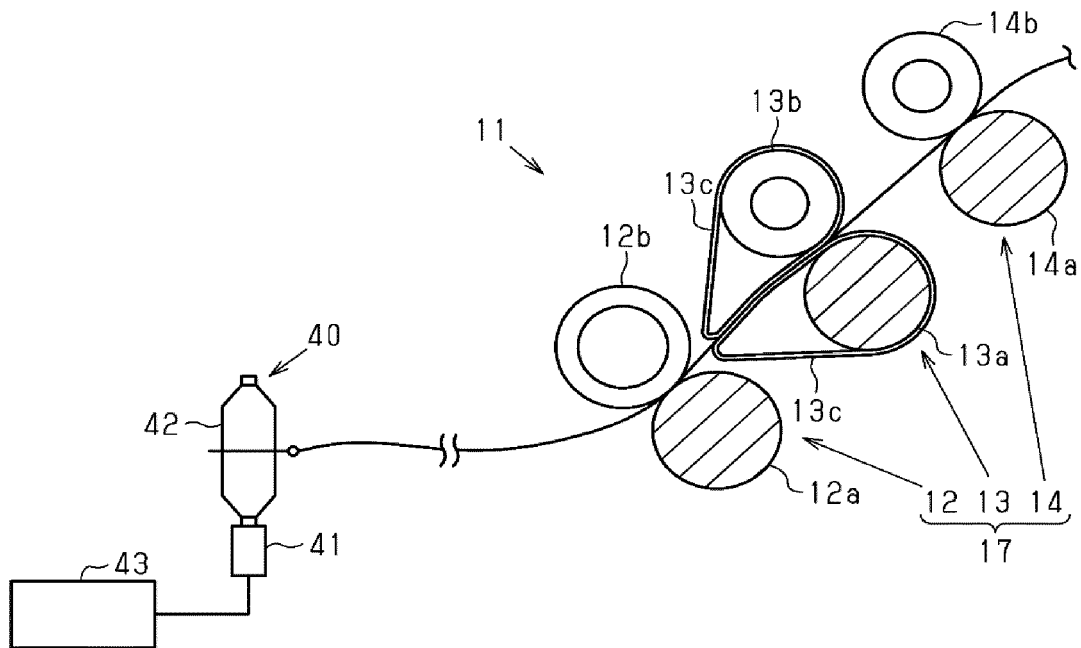


FIG. 4

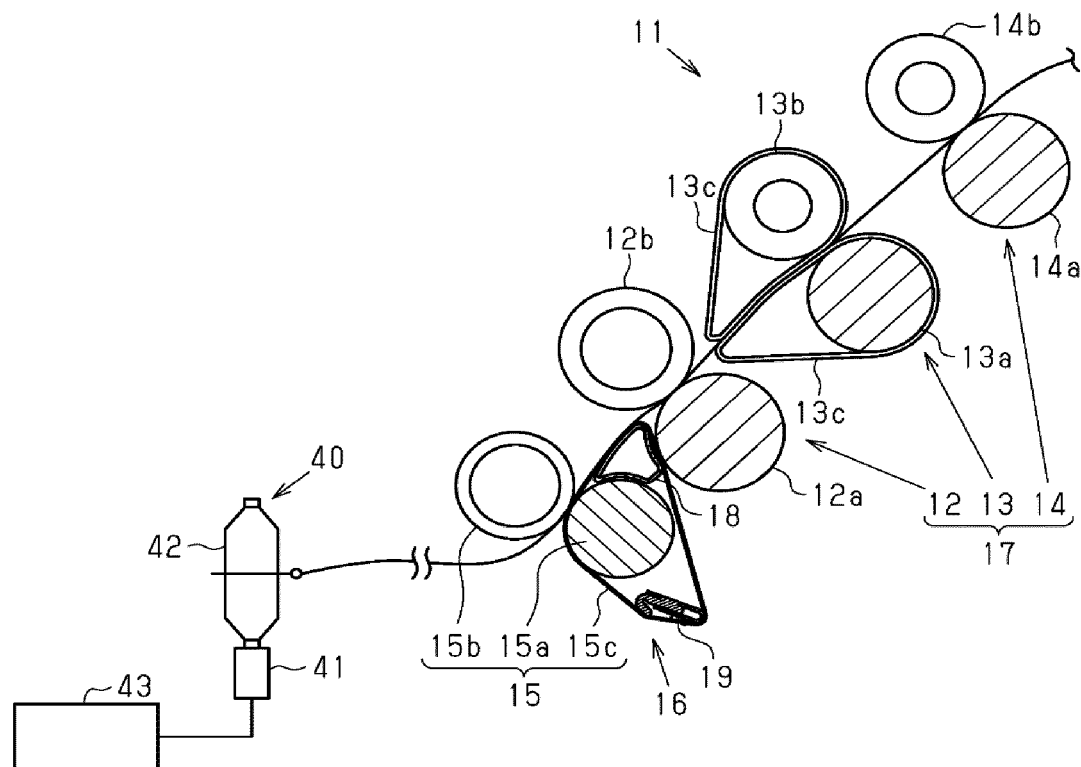


FIG. 5

TENSION DRAFT RATIO	DECR.	REF.	INCR.
DELIVERY ROLLER ROTATIONAL SPEED	CONST.	CONST.	CONST.
FRONT ROLLER ROTATIONAL SPEED	INCR.	REF.	DECR.
MIDDLE ROLLER ROTATIONAL SPEED	CONST.	CONST.	CONST.
BACK ROLLER ROTATIONAL SPEED	CONST.	CONST.	CONST.
TOTAL DRAFT RATIO	CONST.	CONST.	CONST.
MAIN DRAFT RATIO	INCR.	REF.	DECR.
BRAKE DRAFT RATIO	CONST.	CONST.	CONST.

FIG. 6

TENSION DRAFT RATIO	DECR.	REF.	INCR.
DELIVERY ROLLER ROTATIONAL SPEED	CONST.	CONST.	CONST.
FRONT ROLLER ROTATIONAL SPEED	INCR.	REF.	DECR.
MIDDLE ROLLER ROTATIONAL SPEED	INCR.	REF.	DECR.
BACK ROLLER ROTATIONAL SPEED	CONST.	CONST.	CONST.
TOTAL DRAFT RATIO	CONST.	CONST.	CONST.
MAIN DRAFT RATIO	CONST.	CONST.	CONST.
BRAKE DRAFT RATIO	INCR.	REF.	DECR.



EUROPEAN SEARCH REPORT

Application Number

EP 24 16 2911

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 9 228 277 B2 (SCHNEIDER GABRIEL [CH]; MALINA LUDEK [CH] ET AL.) 5 January 2016 (2016-01-05) * column 1, line 5 - line 10 * * column 4, line 40 - column 5, line 11 * * figure 1 * -----	1-5	INV. D01H5/32
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 September 2024	Examiner Humbert, Thomas
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			

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ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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04 - 09 - 2024

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REFERENCES CITED IN THE DESCRIPTION

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