



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.08.2023 Bulletin 2023/35

(51) International Patent Classification (IPC):
D01D 5/092 (2006.01) **D01D 13/02** (2006.01)
D01D 4/04 (2006.01)

(21) Application number: **23150248.5**

(52) Cooperative Patent Classification (CPC):
D01D 5/092; D01D 13/02; D01D 4/04

(22) Date of filing: **04.01.2023**

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

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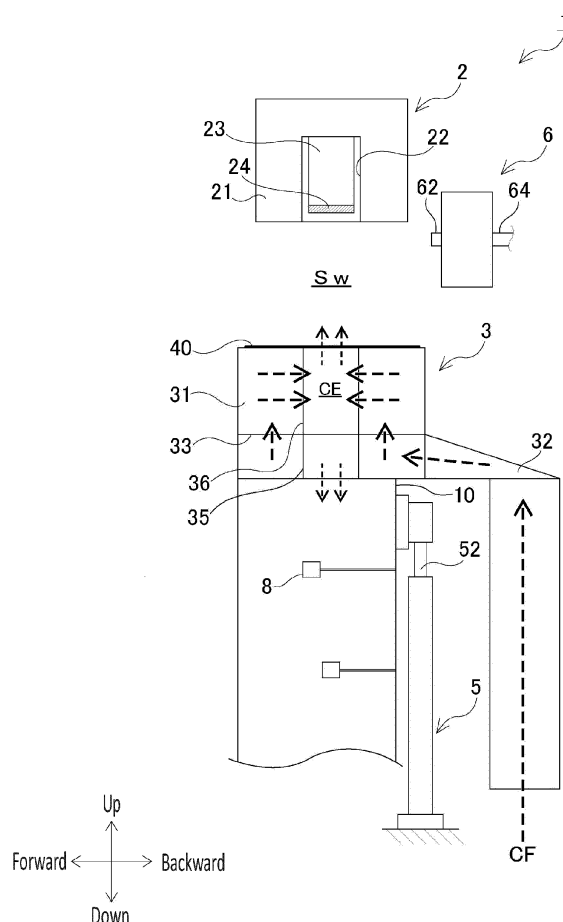
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(30) Priority: **12.01.2022 JP 2022002806**

(54) **SPINNING SYSTEM AND METHOD OF CONTROLLING A SPINNING SYSTEM**

(57) A spinning system configured such that decrease in temperature at a spinneret and in ambient temperature around the spinneret can be suppressed is provided. Such a spinning system includes: a spinning beam 21 having a spinning pack 23 inserted therein including a spinneret 24 for allowing molten polymer P to be spun downward; a cooling unit 3 arranged below the spinning beam 21, including a spinning cylinder 31 extending in an up-and-down direction so as to surround the molten polymer P spun from the spinneret 24, configured to cool the molten polymer P through the use of cooling air CF supplied from a periphery of the spinning cylinder 31; an air cylinder 5 for causing the cooling unit 3 to move downward with respect to the spinning beam 21 so as to form a working space between the cooling unit 3 and the spinning beam 21; and a controller configured to exert control for stopping supply of cooling air CF to the spinning cylinder 31, or control for suppressing supply, to the spinning cylinder 31, of cooling air CF in amount in comparison with a state before spinning of the molten polymer P is stopped, at least when the cooling unit 3 having been caused to move downward with respect to the spinning beam 21.

FIG. 3



Description**BACKGROUND OF THE INVENTION****FIELD OF THE INVENTION**

[0001] The present invention relates to a spinning system and a controlling method thereof.

DESCRIPTION OF THE BACKGROUND ART

[0002] Conventionally, a spinning system has been provided with a cooling unit arranged below a spinning beam having a spinning pack inserted therein including a spinneret for allowing high-temperature molten polymer to be spun therefrom. The cooling unit includes a spinning cylinder surrounding the high-temperature molten polymer spun from the spinneret. The cooling unit is configured to supply cooling air to the spinning cylinder to blow the cooling air on the high-temperature molten polymer so that the molten polymer can be cooled to be solidified, and thereby yarn is formed.

[0003] In order to maintain yarn productivity and quality, the above sort of spinning system has undergone maintenance on a regular basis for cleaning a spinneret surface (hereinafter referred to as "surface cleaning") or exchanging a spinning pack. Patent Document 1, e.g., discloses maintenance on a spinning system conducted while a cooling unit is lowered to ensure a working space between the cooling unit and a spinning beam (see paragraph 0026 in particular). Further, Patent Document 2, e.g., discloses a filament cooling unit elevated and lowered for exchanging a spinning pack or performing surface cleaning (see paragraph 0023 in particular).

(Prior Art Documents)

(Patent Documents)

[0004]

Patent Document 1: Japanese Patent Application Publication No. 2014-145132

Patent Document 2: Japanese Patent Application Publication No. 2005-42227

(Problems to be Solved)

[0005] By such a technique as described in Patent Documents 1, 2, however, there has been a probability that, in lowering and elevating the cooling unit, a temperature at the spinneret and an ambient temperature around the spinneret would decrease significantly due to an upward air flow from the spinning cylinder. For a temperature at the spinneret and an ambient temperature around the spinneret decreasing significantly, a time has been taken to return to their respective original levels from the production started after completion of the main-

tenance. The physical properties of yarn produced in a state of decrease in temperature at the spinneret and in ambient temperature around the spinneret have been degraded to cause technical problems of increase in yarn to be disposed of.

SUMMARY OF THE INVENTION

[0006] The present invention has been made in view of the above-described technical problems. It is the objective of the present invention to provide a spinning system configured such that decrease in temperature at a spinneret and in ambient temperature around the spinneret can be suppressed.

(Means for Solving Problems)

[0007] A first aspect of the present invention is a spinning system comprising:

a spinning beam having a spinning pack inserted therein including a spinneret for allowing molten polymer to be spun downward;

a cooling unit arranged below the spinning beam, including a spinning cylinder extending in an up-and-down direction so as to surround the molten polymer spun from the spinneret, configured to cool the molten polymer through the use of cooling air supplied from a periphery of the spinning cylinder;

a moving mechanism configured to cause the cooling unit to move downward with respect to the spinning beam so as to form a gap between the cooling unit and the spinning beam; and

temperature decrease suppression means configured to, at least when the cooling unit having been caused to move downward with respect to the spinning beam, suppress decrease in temperature at the spinneret.

[0008] According to the above-described first aspect of the spinning system, when the cooling unit having been caused to move for maintenance, decrease in temperature at the spinneret and in ambient temperature around the spinneret can be suppressed, and therefore a time taken for a temperature at the spinneret and an ambient temperature around the spinneret to return to their respective original levels can be shortened. Eventually, a time taken for yarn to be stabilized in physical properties can be shortened, and therefore an amount of yarn to be disposed of can be reduced.

[0009] A second aspect of the spinning system in the above-described first aspect is characterized in that

the temperature decrease suppression means includes

a controller configured to control at least supply of cooling air to the spinning cylinder, wherein the controller is capable of exerting:

control for stopping supply of cooling air to the spinning cylinder; or control for suppressing supply, to the spinning cylinder, of cooling air in amount in comparison with a state before spinning of the molten polymer is stopped, at least when the cooling unit having been caused to move downward with respect to the spinning beam.

[0010] According to the above-described second aspect of the spinning system, at least when the cooling unit having been caused to move downward, it is possible to stop the air flowing or suppress an amount of the air flowing to the spinning cylinder. As a result, decrease in temperature at the spinneret and in ambient temperature around the spinneret both to be caused by the air flowing upward from the spinning cylinder can be suppressed.

[0011] A third aspect of the spinning system in the above-described second aspect is characterized in that

the temperature decrease suppression means further includes

a blower configured to blow air toward between the spinning beam and the cooling unit in a direction intersecting a yarn path of the molten polymer spun from the spinneret.

[0012] According to the above-described third aspect of the spinning system, it is possible to facilitate the yarn threading work after the completion of maintenance while suppressing decrease in temperature at the spinneret and in ambient temperature around the spinneret. More specifically, there are probabilities that stopping supplying the cooling air or suppressing an amount of the supplied cooling air to the spinning cylinder during maintenance on the spinning apparatus would cause the failure to cool and solidify molten polymer spun from the spinneret. Such a failure would impose difficulty in implementing a work itself of threading yarns through the spinning cylinder after the completion of maintenance. By blowing air toward between the spinning beam and the cooling unit in a direction intersecting a yarn path of the molten polymer spun from the spinneret, in spite of stopping supply or reducing an amount of supply of cooling air to the spinning cylinder, it is possible to cool and solidify the molten polymer spun from the spinneret. As a result, it becomes possible to facilitate the yarn threading work of threading yarns through the spinning cylinder to be conducted after the completion of maintenance while suppressing decrease in temperature at the spinneret and in ambient temperature around the spinneret. Besides cooling and solidifying the molten polymer spun from the spinneret, even in the presence of air flowing toward the spinneret, it is possible to block such an air, and eventually to interrupt the air flowing toward the spinneret or reduce an amount of the air flowing toward the spinneret.

[0013] A fourth aspect of the spinning system in the above-described third aspect is characterized in that the blower stops operation when the spinning beam and

the cooling unit about each other.

[0014] According to the above-described fourth aspect of the spinning system, the abutting between the spinning beam and the cooling unit closes an upper opening of the spinning cylinder. The closed upper opening of the spinning cylinder causes the cooling air supplied from the cooling unit to mostly flow downward, and therefore decrease in temperature at the spinneret and in ambient temperature around the spinneret can be suppressed. As a result, a time taken for a temperature at the spinneret and an ambient temperature around the spinneret to return to their respective original levels can be shortened, and eventually, a time taken for yarn to be stabilized in physical properties can be shortened.

[0015] A fifth aspect of the present invention is a method of controlling a spinning system comprising:

a spinning beam having a spinning pack inserted therein including a spinneret for allowing molten polymer to be spun downward; and
a cooling unit arranged below the spinning beam, including a spinning cylinder extending in an up-and-down direction so as to surround the molten polymer spun from the spinneret, configured to cool the molten polymer through the use of cooling air supplied from a periphery of the spinning cylinder, wherein said spinning system performs:

a preparation step of causing the cooling unit to move downward with respect to the spinning beam so as to form a gap between the cooling unit and the spinning beam ;

a temperature decrease suppression step of suppressing decrease in temperature at the spinneret at least when the cooling unit having been caused to move downward with respect to the spinning beam; and

a restoration step of causing the cooling unit to move upward with respect to the spinning beam while suppressing decrease in temperature at the spinneret after the cooling unit having been caused to move downward with respect to the spinning beam so as to undergo maintenance.

[0016] According to the above-described fifth aspect of the controlling method, when the cooling unit having been caused to move down for maintenance, decrease in temperature at the spinneret and in ambient temperature around the spinneret can be suppressed, and therefore a time taken for a temperature at the spinneret and an ambient temperature around the spinneret to return to their respective original levels can be shortened. Eventually, a time taken for yarn to be stabilized in physical properties can be shortened, and therefore an amount of yarn to be disposed of can be reduced.

[0017] A sixth aspect of the controlling method in the above-described fifth aspect is characterized in that the temperature decrease suppression step includes:

a step of stopping supply of cooling air to the spinning cylinder; or a step of suppressing supply, to the spinning cylinder, of cooling air in amount in comparison with a state before the preparation step is performed.

[0018] According to the above-described six aspect of the controlling method, air can be blown to the molten polymer passing through a gap formed between the spinning beam and the cooling unit in a direction intersecting a yarn path of the molten polymer. This makes it possible to cool and solidify the molten polymer spun from the spinneret while suppressing decrease in temperature at the spinneret and in ambient temperature around the spinneret. As a result, yarn threading work of threading yarns through the spinning cylinder can be facilitated. The supply of cooling air to the spinning cylinder may be stopped or an amount of the supplied cooling air may be suppressed at least in a state of having caused the cooling unit to move downward with respect to the spinning beam.

[0019] A seventh aspect of the controlling method in the above-described sixth aspect is characterized in that the temperature decrease suppression step further includes:

an air blowing step of blowing air toward between the spinning beam and the cooling unit in a direction intersecting a yarn path of the molten polymer spun from the spinneret.

[0020] According to the above-described seventh aspect of the controlling method, it is possible to facilitate the yarn threading work after the completion of maintenance while suppressing decrease in temperature at the spinneret and in ambient temperature around the spinneret. More specifically, there are probabilities that stopping supplying the cooling air or suppressing an amount of the supplied cooling air to the spinning cylinder during maintenance on the spinning apparatus would cause the failure to cool and solidify molten polymer spun from the spinneret. Such a failure would impose difficulty in implementing a work itself of threading yarns through the spinning cylinder after the completion of maintenance. By blowing air toward between the spinning beam and the cooling unit in a direction intersecting a yarn path of the molten polymer spun from the spinneret, in spite of stopping supply or reducing an amount of supply of cooling air to the spinning cylinder, it is possible to cool and solidify the molten polymer spun from the spinneret. As a result, it becomes possible to facilitate the yarn threading work of threading yarns through the spinning cylinder to be conducted after the completion of maintenance while suppressing decrease in temperature at the spinneret and in ambient temperature around the spinneret. Besides cooling and solidifying the molten polymer spun from the spinneret, even in the presence of air flowing toward the spinneret, it is possible to block such an air, and eventually to interrupt the air flowing toward the spinneret or reduce an amount of the air flowing toward the spinneret.

[0021] An eighth aspect of the controlling method in

the above-described seventh aspect is characterized in that, in the air blowing step, blowing air is finished, during performance of the restoration step, after having undergone maintenance, or when the restoration step having been finished.

[0022] According to the above-described eighth aspect of the controlling method, when the restoration step having been finished, an upper opening of the spinning cylinder is closed. The closed upper opening of the spinning cylinder causes the cooling air supplied from the cooling unit to mostly flow downward, and therefore decrease in temperature at the spinneret and in ambient temperature around the spinneret can be suppressed. As a result, a time taken for a temperature at the spinneret and an ambient temperature around the spinneret to return to their respective original levels can be shortened, and eventually, a time taken for yarn to be stabilized in physical properties can be shortened.

[0023] The spinning system according to the present invention does not necessarily include all the above-described first aspect to fourth aspect. The invention in the above-described first aspect, e.g., does not need to encompass all the inventions in the above-described second aspect to fourth aspect. The present invention may be obtained by arbitrarily combining the first aspect and at least a part of the second aspect, or by arbitrarily combining the first aspect and at least a part of the third aspect, or by arbitrarily combining the first aspect, at least a part of the second aspect, and at least a part of the third aspect, or by arbitrarily combining the first aspect, at least a part of the second aspect, at least a part of the third aspect, and at least a part of the fourth aspect, to such an extent that consistency can be achieved. In a similar manner, the controlling method according to the present invention does not necessarily include all the above-described fifth aspect to eighth aspect. The invention in the above-described fifth aspect, e.g., does not need to encompass all the inventions in the above-described sixth aspect to eighth aspect. The present invention may be obtained by arbitrarily combining the fifth aspect and at least a part of the sixth aspect, or by arbitrarily combining the fifth aspect and at least a part of the seventh aspect, or by arbitrarily combining the fifth aspect, at least a part of the sixth aspect, and at least a part of the seventh aspect, or by arbitrarily combining the fifth aspect, at least a part of the sixth aspect, at least a part of the seventh aspect, and at least a part of the eighth aspect, to such an extent that consistency can be achieved.

(Advantageous Effects of the Invention)

[0024] According to the present invention, it is possible to provide a spinning system configured such that decrease in temperature at a spinneret and in ambient temperature around the spinneret can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 depicts an example of side view taken schematically from a right side with respect to a part of a spinning system according to an embodiment of the present invention; 5

FIG. 2 depicts an example of front view taken schematically from a forward side with respect to a part of the spinning system shown in FIG. 1; 10

FIG. 3 depicts an example of schematic view of the spinning system in a state of having caused a cooling unit to move down in the spinning system shown in FIG. 1; 15

FIG. 4 depicts an example of function block diagram schematically showing an electrically-connected configuration of the spinning system;

FIG. 5 depicts an example of explanatory view of a maintenance step of a conventional spinning system schematically showing a part thereof in an operational state; 20

FIG. 6 depicts an example of explanatory view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of stopping the spinning of molten polymer; 25

FIG. 7 depicts an exemplary view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of having caused a cooling unit to move down to a lower end with respect to a spinning beam; 30

FIG. 8 depicts an example of explanatory view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of allowing a spinning pack to be exchanged; 35

FIG. 9 depicts an example of explanatory view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of restarting the spinning of molten polymer;

FIG. 10 depicts an example of explanatory view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of allowing a cover for covering an upper opening of a spinning cylinder to be detached; 40

FIG. 11 depicts an example of explanatory view of a maintenance step of the conventional spinning system schematically showing a part thereof in a state of allowing a spinning cylinder to have yarn threaded therethrough in yarn threading work; 45

FIG. 12 depicts an example of schematic diagram showing a result of circular knit staining evaluation changed with the passage of time from the restoration to an operational state after the maintenance in a conventional maintenance step;

FIG. 13 depicts a graph showing a result of thermal stress and de-twisting tension on yarn changed with the passage of time from the restoration to an operational state after the maintenance in a conventional

maintenance step;

FIG. 14 depicts a graph showing a surface temperature of a spinneret changed with the passage of time from the starting of maintenance in a conventional maintenance step;

FIG. 15 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part of a spinning system when having stopped supply of cooling air to the spinning cylinder;

FIG. 16 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part of the spinning system in surface cleaning of a spinneret;

FIG. 17 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part of the spinning system in a state of restarting the spinning of molten polymer from the spinneret;

FIG. 18 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part of the spinning system in a state of allowing a cover for covering an upper opening of a spinning cylinder to be detached;

FIG. 19 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part of the spinning system in a state of allowing the spinning cylinder to have yarn threaded therethrough in yarn threading work;

FIG. 20 depicts an example of explanatory view of a maintenance step according to an embodiment of the present invention schematically showing a part thereof in an operational state;

FIG. 21 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of stopping the spinning of molten polymer;

FIG. 22 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of having caused the cooling unit to move down to a lower end with respect to the spinning beam;

FIG. 23 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of restarting the spinning of molten polymer;

FIG. 24 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of causing a blower to start operation;

FIG. 25 depicts an example of explanatory view of

a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of allowing the spinning cylinder to have yarn threaded there-through in yarn threading work;

FIG. 26 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of having caused the cooling unit to move up to an upper end with respect to the spinning beam;

FIG. 27 depicts an example of explanatory view of a maintenance step according to a modified embodiment of the present invention schematically showing a part of the spinning system in a state of being restored to an operational state;

FIG. 28 depicts an example of schematic diagram showing a result of circular knit staining evaluation changed with the passage of time from the restoration to an operational state after the maintenance step according to an embodiment of the present invention;

FIG. 29 depicts an example of graph showing results of thermal stress and de-twisting tension on yarn changed with the passage of time from the restoration to an operational state after the maintenance in their respective steps of conventional maintenance and maintenance according to a modified embodiment of the present invention; and

FIG. 30 depicts an example of graph showing levels of surface temperature of a spinneret changed with the passage of time from the starting of maintenance in their respective steps of: conventional maintenance; maintenance according to an embodiment of the present invention; and maintenance according to a modified embodiment of the present invention.

DESCRIPTIONS OF EMBODIMENTS OF THE INVENTION

[0026] An embodiment of the present invention will be described with reference to the drawings hereinafter. For the convenience of description, an up-and-down direction, a left-and-right direction, and a forward-and-backward direction are as shown in their respective drawings to be described later.

[1. Outline of Spinning System]

[0027] First, an outline of a spinning system 1 according to an embodiment of the present invention will be described. FIG. 1 depicts an example of side view taken schematically from a right side with respect to a part of the spinning system 1 according to an embodiment of the present invention. FIG. 2 depicts an example of front view taken schematically from a forward side with respect to a part of the spinning system 1 shown in FIG. 1. FIG. 3 depicts an example of schematic view of the spinning

system in a state of having caused a cooling unit 3 to move down in the spinning system 1 shown in FIG. 1. The illustrations of a polymer tank 25 and a polymer pipe 26 shown in FIG. 2 are omitted from FIGS. 1 and 3. While illustrations of molten polymer P and a yarn Y are omitted from FIG. 3 for the sake of convenience, the yarn Y may be formed as a result of spinning the molten polymer P from a spinneret 24, when the cooling unit 3 is caused to move down, so that the spun molten polymer P is cooled to be solidified through the use of the cooling unit 3 or under other conditions.

[0028] The spinning system 1 according to an embodiment of the present invention is a system for producing a yarn Y made of synthetic fibers. As shown in FIG. 1, e.g., the spinning system 1 includes a spinning unit 2, a cooling unit 3, a moving mechanism 5, a blower 6, and a controller 7 (see FIG. 4 to be described later). In addition to these structures, the spinning system 1 includes an oil-agent application unit 8, a take-up unit (not shown), a winder (not shown), and the like. Descriptions of such structures are however omitted here.

[Spinning Unit]

[0029] As shown in FIG. 1 or 2, the spinning unit 2 is a melt spinning unit configured to spin molten polymer P as material of a yarn Y. The spinning unit 2 includes a spinning beam 21 having a substantially rectangular-solid shape, a plurality of pack housings 22 formed in the spinning beam 21, a plurality of spinning packs 23 (whose number is the same as, e.g., the number of the plurality of pack housings 22) arranged respectively in the plurality of pack housings 22, a polymer tank 25 having polymer stored therein, and a plurality of polymer pipes 26 connecting between their respective spinning packs 23 and the polymer tank 25.

[0030] For the sake of convenience, three pack housings 22 and three spinning packs 23 are shown in FIG. 2. However, the invention is not limited to such a configuration. A larger number of pack housings 22 and a larger number of spinning packs 23 (e.g., twelve) may be provided.

[0031] Polymer in the polymer tank 25 is fed through the plurality of polymer pipes 26 to the plurality of spinning packs 23. In feeding the polymer from the polymer tank 25 to the spinning pack 23, the polymer in the polymer tank 25 and in the polymer pipe 26 is heated by the spinning beam 21 to a predetermined temperature (e.g., 300 °C) to become molten polymer.

[0032] High-temperature heated molten polymer in a liquid state is supplied through the polymer pipe 26 to each spinning pack 23. A spinneret 24 is arranged at a lower end portion of each spinning pack 23. That is, the number of the spinnerets 24 is the same as that of the spinning packs 23. The spinneret 24 has, e.g., a plurality of nozzles (not shown). The spinning pack 23 ejects molten polymer P through the plurality of nozzles of the spinneret 24 (in other words, spins a plurality of yarns Y). The

molten polymer P ejected through the plurality of nozzles is cooled by the cooling unit 3 to become the plurality of yarns Y having a plurality of filaments. Specifically, one yarn Y is spun from one spinneret 24. Each spinneret 24 is not necessarily required to have a plurality of nozzles but may have only one nozzle. In such a case, the yarn Y is produced as monofilament yarn.

[Cooling Unit]

[0033] As shown in FIG. 1, the cooling unit 3 includes a spinning cylinder 31 arranged below the spinning unit 2, a duct 32 connected to the spinning cylinder 31, and a first compressed-air source 37 (see FIG. 4 to be described later) configured to supply cooling air CF to the spinning cylinder 31 through the duct 32. In an embodiment of the present invention, a cyclic yarn cooling unit, e.g., is used as the cooling unit 3. The spinning cylinder 31 is e.g. a hollow box body, and extends in an up-and-down direction so as to surround the molten polymer spun from the spinneret 24 (so as to locate the molten polymer P in a hollow area CE). The spinning cylinder 31 includes a flow straightening plate 33 provided therein. Air for cooling (the air will be called "cooling air CF") supplied from the first compressed-air source 37 passes through the inside of the duct 32 and is supplied into lower space (space under the flow straightening plate 33) of the spinning cylinder 31. The cooling air CF having flowed into the lower space of the spinning cylinder 31 passes through the flow straightening plate 33 to be straightened upward, and then flows into upper space (space over the flow straightening plate 33) of the spinning cylinder 31. A plurality of partitioning cylinders 35 is arranged at a position directly below a filter member 36. The partitioning cylinder 35 is configured to prevent transmission of the cooling air CF in a radial direction of the partitioning cylinder 35, thereby preventing the cooling air CF from flowing from the lower space of the spinning cylinder 31 directly into the hollow area CE. The cooling air CF having flowed into the upper space of the spinning cylinder 31 is straightened in passing through the filter member 36 having, e.g., a punching filter and a cooling filter, and then flows into the hollow area CE. In such a manner, the cooling air CF is blown on a yarn material from a periphery of the filter member 36, more specifically, from an entire outer perimeter of the filter member 36. As a result, the yarn material is cooled to become the yarn Y. A sealing member 40 is provided at a place where the spinning beam 21 and the spinning cylinder 31 are in abutting contact with each other. The sealing member 40 can be used for preventing leakage from a surface of the abutting contact between the spinning beam 21 and the spinning cylinder 31.

[Moving Mechanism]

[0034] The moving mechanism 5 having e.g. an air cylinder (the moving mechanism 5 will be called an air cyl-

inder 5) is configured to cause the cooling unit 3 to move up and down. More specifically, the air cylinder 5 is standing upright on, e.g., a floor surface of a factory. The air cylinder 5 has a piston rod 52 extending longitudinally in an up-and-down direction arranged so as to be expandable/contractible in an up-and-down direction. The spinning cylinder 31 has a lower end fixed with a wall member 10 extending downward. The wall member 10 has a side surface fixed with a tip of the piston rod 52. In such a configuration, the cooling unit 3 is entirely movable by the actuation of the air cylinder 5 between a first position (see FIG. 1) corresponding to an operational state where the spinning system 1 is in an operational state and a second position (see FIG. 3) below the first position. The cooling unit 3 is caused to move up in response to the actuation of the piston rod 52 of the air cylinder 5 in an expanding direction (upward direction in FIG. 1) and is caused to move down in response to the actuation of the piston rod 52 in a contracting direction (downward direction in FIG. 1). The production of the yarn Y is feasible when the cooling unit 3 is at the first position. When the cooling unit 3 is at the first position, a force acting upward (toward the spinning beam 21) is applied to the cooling unit 3 by the air cylinder 5. When the cooling unit 3 is at the second position, a gap is formed as a working space Sw between the spinning unit 2 (more specifically, the spinning beam 21) and the cooling unit 3 as viewed in an up-and-down direction. Hereinafter, for the sake of convenience, the foregoing "first position" will be called an "upper end" and the foregoing "second position" will be called a "lower end." However, the "first position" is not limited to the upper end, and the "second position" is not limited to the lower end.

[Blower]

[0035] As shown in FIG. 3, the blower 6 is a device configured to blow side air SF such that the side air SF flows in a substantially horizontal direction in a working space Sw when the cooling unit 3 is at the lower end. In this specification, "blowing" of air may also be called "release."

[0036] The blower 6 includes, e.g., a second compressed-air source 66 (see FIG. 4 to be described later), a plurality of air nozzles 62 through which air (e.g., compressed air) supplied from the second compressed-air source 66 is releasable as the side air SF, an air pipe 64 connecting the second compressed-air source 66 and each air nozzle 62, and the like. The plurality of air nozzles 62 corresponding to the plurality of spinning packs 23, respectively, are arranged side by side in a left-and-right direction. In an embodiment of the present invention, the plurality of air nozzles 62 are arranged so as to cause the side air SF released from the air nozzle 62 to flow in one direction from a backward side toward a forward side in a working space Sw formed between the spinning unit 2 and the cooling unit 3 as viewed in an up-and-down direction. The reason for causing the side air SF released

from the plurality of air nozzles 62 to flow in one direction is to prevent flows of the cooling air CF directed in different directions from interfering with each other.

[0037] It is not necessarily required to arrange the plurality of air nozzles 62 so as to cause side air SF to flow from a backward side toward a forward side. The air nozzles 62 may be arranged so as to, e.g., cause the side air SF to flow from a forward side toward a backward side. The plurality of air nozzles 62 may alternatively be arranged so as to cause the side air SF to flow from a left side toward a right side. In consideration of attenuation of the flow rate of the side air SF with a greater distance from the air nozzle 62, however, the plurality of air nozzles 62 are preferably arranged so as to cause the side air SF to flow from a backward side toward a forward side, and vice versa.

[0038] It is not necessarily required to provide the plurality of air nozzles 62 corresponding to the plurality of spinning packs 23, respectively. The plurality of air nozzles 62 may be replaced, e.g., with a single flat nozzle having a greater width than a length in a left-and-right direction from a spinning pack 23 at the left end to a spinning pack 23 at the right end.

[0039] The reason for causing the side air SF released from the air nozzle 62 to flow in a substantially horizontal direction in a working space Sw is to prevent the side air SF released from the air nozzle 62 from going toward the spinneret 24 and toward a place around the spinneret 24. Thus, as long as compressed air released from the air nozzle 62 does not go toward the spinneret 24 and toward a place around the spinneret 24, the air nozzles 62 are not necessarily required to be arranged so as to cause the compressed air released from the air nozzles 62 to flow as the side air SF in a substantially horizontal direction. The air nozzles 62 may be arranged so as to, e.g., cause the compressed air released from the air nozzles 62 to flow diagonally downward. In another case, the air nozzles 62 may be arranged so as to cause the compressed air released from the air nozzles 62 to flow diagonally upward.

[0040] In an embodiment of the present invention, the second compressed-air source 66 for supplying compressed air to the air nozzle 62 and the first compressed-air source 37 for supplying the cooling air CF to the spinning cylinder 31 are provided separately. However, the invention is not limited to such a configuration. A common compressed-air source may be provided for supplying compressed air to both of the air nozzle 62 and the spinning cylinder 31. Further, it is not necessarily required to connect the second compressed-air source 66 and each air nozzle 62 through the air pipe 64. An air hose, e.g., may be used for the connection.

[Controller]

[0041] FIG. 4 depicts an example of function block diagram schematically showing an electrically-connected configuration of the spinning system 1. The controller 7

is configured to perform processing relating to operation of the spinning system 1. The controller 7 is responsible for controls such as operation and stop of the spinning of molten polymer P from the spinneret 24, actuation and stop of the air cylinder 5, regulation of the flow rate of cooling air CF supplied to the spinning cylinder 31, i.e., into the hollow area CE, and regulation of the flow rate of compressed air released from the air nozzle 62 forming the blower 6. It is to be noted that "temperature decrease suppression means" includes the controller 7.

[0042] The controller 7 includes a CPU, ROM, RAM, and the like. The controller 7 is connected electrically to units including an operation unit 72 having buttons and the like operable by an operator, an upper end detection sensor 76 for determining that the cooling unit 3 is at the upper end, and a lower end detection sensor 78 for determining that the cooling unit 3 is at the lower end. The controller 7 is configured to receive signals from the units including the operation unit 72, the upper end detection sensor 76, and the lower end detection sensor 78.

[0043] The controller 7 is further connected electrically to units including a gear pump 28 capable of causing the spinning of the molten polymer P from the spinneret 24, the first compressed-air source 37, the second compressed-air source 66, and a solenoid 74 configured to actuate the air cylinder. On the basis of receipt of various sorts of signals from the units including the operation unit 72, the upper end detection sensor 76, and the lower end detection sensor 78, the controller 7 controls the units including the gear pump 28, the first compressed-air source 37, the second compressed-air source 66, and the solenoid 74. The controller 7 controls the solenoid 74 to control actuation of the air cylinder 5.

[0044] In response to control over the first compressed-air source 37, the flow rate of the cooling air CF (hereinafter referred to as "air volume") supplied to the spinning cylinder 31 is controlled. In response to control over the second compressed-air source 66, the flow rate of the side air SF (hereinafter referred to as "air volume" like the cooling air CF) released from the air nozzle 62 is controlled.

[0045] The cooling air CF supplied to the spinning cylinder 31 may be controlled by an automatic valve arranged upstream from the duct 32 instead of operation or stop of the first compressed-air source 37. The air volume of the side air SF released from the air nozzle 62 may be controlled by an automatic valve arranged upstream from the air nozzle 62.

[2. Maintenance Step]

[0046] Second, a maintenance step to be undergone by a spinning system will be described. Before description of such a maintenance step according to an embodiment of the present invention conducted for the spinning system 1, a conventional maintenance step will be described by referring to FIGS. 5 to 11. In describing the conventional maintenance step, signs given to various

structures forming the spinning system 1 according to an embodiment of the present invention are applied as they are to the corresponding structures (including a spinning unit and a cooling unit) forming a conventional spinning system 100. Meanwhile, the conventional spinning system 100 does not include the above-described blower 6.

[2-1. Conventional maintenance step in conventional spinning system]

[0047] FIG. 5 depicts an example of explanatory view of a maintenance step of the conventional spinning system 100 schematically showing a part thereof in an operational state. While the spinning system 100 is in an operational state, the spinning beam 21 and the cooling unit 3 are in abutting contact with each other. While the spinning system 100 is in operation, the molten polymer P is spun from the spinneret 24 and the cooling air CF is supplied from the first compressed-air source 37 to the spinning cylinder 31 through the duct 32. The cooling air CF supplied to the spinning cylinder 31 flows in a substantially horizontal direction into the hollow area CE to cool the molten polymer P spun from the spinneret 24.

[2-1-1. Preparation step]

[0048] FIG. 6 depicts an example of explanatory view of a maintenance step of the conventional spinning step schematically showing a part thereof in a state of stopping the spinning of molten polymer 100 in a state where the spinning of the molten polymer P. For the maintenance on the spinning system 100, the spinning of the molten polymer P from the spinneret 24 is stopped first, as shown in FIG. 6. The spinning of the molten polymer P is stopped by the controller 7 in response to the operation by, e.g., an operator. During the maintenance, supply of the cooling air CF by the cooling unit 3 is continued. In the present specification, the maintenance corresponds to, e.g., surface cleaning of the spinneret 24 or exchange of the spinning pack 23.

[0049] FIG. 7 depicts an exemplary view of a maintenance step of the conventional spinning system 100 schematically showing a part thereof in a state of having caused the cooling unit 3 to move down to the lower end with respect to the spinning beam 21. After stopping the spinning of the molten polymer P, the controller 7 actuates the air cylinder 5 in a contracting direction to lower the cooling unit 3 with respect to the spinning beam 21, as shown in FIG. 7. Causing the cooling unit 3 to move down with respect to the spinning beam 21 forms the working space Sw between the spinning unit 2 and the cooling unit 3 as viewed in the up-and-down direction. When the cooling unit 3 is caused to move down with respect to the spinning beam 21, the operator immediately conducts work of covering an upper opening of the spinning cylinder 31 with a cover 42. Covering the upper opening of the spinning cylinder 31 with the cover 42 makes it possible to stop an upward air flow (namely, the

cooling air CF) from the upper opening of the spinning cylinder 31.

[2-1-2. Maintenance main step]

[0050] After covering the upper opening of the spinning cylinder 31 with the cover 42, the operator conducts the maintenance. The detail of the maintenance includes surface cleaning of the spinneret 24 and exchange of the spinning pack 23. While a time required for the maintenance is determined in a manner depending upon a detail of the maintenance, it is generally 10 minutes. The operator conducts surface cleaning of the spinneret 24 or exchange of the spinning pack 23 in response to purpose. FIG. 8 depicts an example of explanatory view of a maintenance step of the conventional spinning system 100 schematically showing a part thereof in a state of allowing the spinning pack 23 to be exchanged.

[2-1-3. Molten polymer spinning restarting step]

[0051] FIG. 9 depicts an example of explanatory view of a maintenance step of the conventional spinning system showing a part of the spinning system 100 in a state where the spinning of the molten polymer P is restarted. After implementation of the maintenance, in response to operation by the operator, e.g., the controller 7 starts (restarts) the spinning of the molten polymer P from the spinneret 24, as shown in FIG. 9.

[2-1-4. Cover detaching step]

[0052] FIG. 10 depicts an example of explanatory view of the maintenance step of the spinning system 100 schematically showing a part thereof in a state of allowing the cover 42 for covering the upper opening of the spinning cylinder 31 to be detached. As shown in FIG. 10, when the spinning of the molten polymer P is restarted, the operator conducts work of detaching the cover 42 covering the upper opening of the spinning cylinder 31.

[2-1-5. Yarn threading step]

[0053] FIG. 11 depicts an example of explanatory view of the maintenance step of the spinning system 100 schematically showing a part thereof in a state of allowing the spinning cylinder 31 to have yarn threaded therethrough in yarn threading work. As shown in FIG. 11, after implementation of the work of detaching the cover 42 covering the upper opening of the spinning cylinder 31, the operator conducts yarn threading work of threading the molten polymer P spun from the spinneret 24 (or cooled and solidified yarn Y) through the spinning cylinder 31.

[2-1-6. Restoration step]

[0054] After implementation of the yarn threading work, in response to operation by the operator, e.g., the

controller 7 actuates the air cylinder 5 in an expanding direction to cause the cooling unit 3 to move up so as to make the cooling unit 3 get closer to the spinning beam 21. When the upper end detection sensor 76 (see FIG. 4) determines that the cooling unit 3 is at the upper end, the controller 7 stops actuation of the air cylinder 5, thereby stopping elevation of the cooling unit 3. When the cooling unit 3 stops at the upper end, the spinning beam 21 and the cooling unit 3 abut each other across the sealing member 40. While other preparations for starting production are made in the restoration step, illustrations of these other preparations are omitted.

[0055] After implementation of the restoration step, the spinning system 100 works normally to be in a state of production. The maintenance on the spinning system 100 has conventionally been conducted through the above-described steps.

[2-1-7. Problems in conventional maintenance step or the like]

[0056] If restoration is made to a working state after implementation of the maintenance through the above-described conventional maintenance step, the physical properties of yarn are degraded. As shown in FIGS. 12 and 13, e.g., considerable time is required to recover normal physical properties of the yarn (specifically, for the yarn to be determined to be normal). FIG. 12 depicts an example of schematic diagram showing a result of circular knit staining evaluation changed with the passage of time from the restoration to an operational state after the maintenance in the conventional maintenance step. FIG. 13 depicts a graph showing a result of thermal stress and de-twisting tension on yarn changed with the passage of time from the restoration to an operational state after the maintenance in the conventional maintenance step.

[0057] As shown in FIG. 12, the result about circular knit staining evaluation is such that, even after passage of about 60 minutes from restoration to a working state, a color is still lighter than a benchmark as a reference (hereinafter called "B. M") so the yarn is not determined to be normal. After passage of about 70 minutes from the restoration to the working state, a color approximate to the B. M is obtained so the yarn is determined to be normal.

[0058] As shown in FIG. 13, both the de-twisting tension and the thermal stress take values approximate to reference values after passage of about 80 to 90 minutes from restoration to a working state. As shown in FIG. 13, while B. M as a reference value for the de-twisting tension is about 30.8 [cN], e.g., and B. M as a reference value for the thermal stress is about 83.1 [cN], e.g., the B. M changes in response to the sort of yarn, and the like.

[0059] As described above, after maintenance is conducted by the conventional maintenance step and then restoration is made to a working state, considerable time is required to recover normal physical properties of yarn.

Hence, producing the yarn continuously merely results in increased amount of the yarn to be disposed of. In a case where maintenance is conducted by the conventional maintenance step and then restoration is made to a working state, possible reason for requiring considerable time to recover normal physical properties of the yarn is that temperature at the spinneret 24 and ambient temperature around the spinneret 24 decrease seriously in the maintenance step so it takes time for temperature at the spinneret 24 and ambient temperature around the spinneret 24 to recover their original temperatures.

[0060] FIG. 14 depicts a graph showing a surface temperature of the spinneret 24 changed with the passage of time from the starting of maintenance in the conventional maintenance step. As shown in FIG. 14, when the cooling unit 3 is caused to move down with respect to the spinning beam 21, surface temperature on the spinneret 24 decreases nearly continuously to cause serious decrease of surface temperature on the spinneret 24 at a time when the maintenance is finished. When the maintenance is finished and the cooling unit 3 is caused to move up so as to get closer to the spinning beam 21, surface temperature on the spinneret 24 is recovered gradually. As shown in FIG. 14, in order for surface temperature on the spinneret 24 to recover its original temperature (e.g., temperature before implementation of the maintenance), a duration of about 2000 s or more is required from start of the elevation of the cooling unit 3.

[0061] Possible reason for the serious decrease of surface temperature on the spinneret 24 occurring in the conventional maintenance step is that the cooling air CF supplied to the spinning cylinder 31 goes upward from the upper opening of the spinning cylinder 31. During implementation of the yarn threading work of threading the molten polymer P spun from the spinneret 24 (or cooled and solidified yarn Y) through the spinning cylinder 31, the molten polymer P is cooled and solidified by the cooling air CF (see, e.g., FIG. 11) flowing upward from the upper opening of the spinning cylinder 31. In this case, while the operator is allowed to conduct the yarn threading work without using a tool, temperature at the spinneret 24 and ambient temperature around the spinneret 24 are unintentionally decreased by the cooling air CF flowing upward from the upper opening of the spinning cylinder 31. This causes serious decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24. Hence, it is considered that, after restoration to a working state, it takes time for temperature at the spinneret 24 and ambient temperature around the spinneret 24 to recover their original temperatures.

[0062] To solve the above-described problem revealed in the conventional maintenance step, maintenance is conducted on the spinning system 1 according to the embodiment of the present invention by a maintenance step described below. The following describes the maintenance step conducted on the spinning system 1 according to the embodiment of the present invention.

[2-2. Maintenance step according to embodiment of present invention]

[0063] The maintenance step according to the present invention will be described by referring to FIGS. 5, 6, and 15 to 20. The spinning system 1 according to the embodiment of the present invention largely differs from the conventional spinning system 100 in that the cooling air CF is not supplied to the spinning cylinder 31 in the maintenance step. Since the blower 6 is not in operation in the maintenance step 6, it is to be noted that the spinning system 1 according to the embodiment of the present invention does not necessarily include such a blower 6. The illustration of blower 6 is omitted from FIGS. 15 to 20.

[0064] As shown in FIG. 5, while the spinning system 1 is working, the lower end of the spinning beam 21 and the upper end of the cooling unit 3 are in abutting contact with each other. While the spinning system 1 is working, the molten polymer P is spun from the spinneret 24 and the cooling air CF is supplied from the first compressed-air source 37 (see FIG. 4 and the same applies to the following cases) to the spinning cylinder 31 through the duct 32. The cooling air CF supplied to the spinning cylinder 31 flows in a substantially horizontal direction into the hollow area CE to cool the molten polymer P spun from the spinneret 24.

[2-2-1. Preparation step]

[0065] For implementation of maintenance on the spinning system 1, the spinning of the molten polymer P from the spinneret 24 is stopped first, as shown in FIG. 6. The spinning of the molten polymer P is stopped by the controller 7 in response to operation by, e.g., an operator.

[0066] FIG. 15 depicts an example of view schematically showing a part of the spinning system 1 when the supply of cooling air CF to the spinning cylinder 31 having been stopped. Under control by the controller 7, after the spinning of molten polymer P from the spinneret 24 having been stopped, the operation of, e.g., the compressed-air source 37 is stopped, and the supply of cooling air CF to the spinning cylinder 31 is stopped, as shown in, e.g., FIG. 15.

[0067] FIG. 16 depicts an example of view schematically showing a part of the spinning system 1 in a state of having caused the cooling unit 3 to move down to a lower end with respect to the spinning beam 1. After stopping the supply of the cooling air CF to the spinning cylinder 31, the controller 7 actuates the air cylinder 5 in a contracting direction to lower the cooling unit 3 with respect to the spinning beam 21, as shown in FIG. 16. Causing the cooling unit 3 to move down with respect to the spinning beam 21 forms the working space Sw between the spinning unit 2 and the cooling unit 3 as viewed in an up-and-down direction. When the cooling unit 3 is caused to move down with respect to the spinning beam 21, the operator conducts work of covering the upper opening of the spinning cylinder 31 with the cover 42.

Covering the upper opening of the spinning cylinder 31 with the cover 42 is not necessarily conducted, however, because the supply of cooling air CF to the spinning cylinder 31 is stopped.

[0068] Preferably, timing of stopping the spinning of the molten polymer P coincides with a moment before start of causing the cooling unit 3 to move down with respect to the spinning beam 21. However, this is not the only timing but the spinning may be stopped during causing the cooling unit 3 to move down with respect to the spinning beam 21 or after causing the cooling unit 3 to move down to the lower end with respect to the spinning beam 21.

[0069] Timing of stopping supply of the cooling air CF to the spinning cylinder 31 is not limited to a moment after the spinning of the molten polymer P is stopped but may coincide with a moment before the spinning of the molten polymer P is stopped or with a moment substantially simultaneous with stop of the spinning of the molten polymer P.

[2-2-2. Maintenance main step]

[0070] After covering the upper opening of the spinning cylinder 31 with the cover 42, which is not necessarily to be conducted, the operator conducts the maintenance including surface cleaning of the spinneret 24 and exchange of the spinning pack 23 in accordance with the purposes. While time required for the maintenance is determined in a manner that depends on the detail of the maintenance, it is generally 10 minutes.

[2-2-3. Molten polymer spinning restarting step]

[0071] FIG. 17 depicts an example of view schematically showing a part of the spinning system 1 in a state of restarting the spinning of molten polymer from the spinneret 24. After implementation of the maintenance, in response to operation by the operator, e.g., the controller 7 starts (restarts) the spinning of the molten polymer P from the spinneret 24, as shown in FIG. 17.

[2-2-4. Cover detaching step]

[0072] FIG. 18 depicts an example of view schematically showing a part of the spinning system 1 in a state of allowing the cover 42 for covering the upper opening of the spinning cylinder 31 to be detached. As shown in FIG. 10, when the spinning of the molten polymer P is restarted, the operator conducts work of detaching the cover 42 covering the upper opening of the spinning cylinder 31. If the upper opening of the spinning cylinder 31 is covered with the cover 42, the operator conducts a work of detaching the cover 42 after the molten polymer P from the spinneret 24 having been started (restarted). At this time, since the supply of cooling air CF to the spinning cylinder 31 is stopped, such a cooling air CF does not flow upward from the upper opening of the spin-

ning cylinder 31.

[2-2-5. Temperature decrease suppression step]

[0073] Timing of stopping the supply of cooling air CF to the spinning cylinder 31 is as has been described above. If the upper opening of the spinning cylinder 31 is covered with the cover 42, it is only required to stop the supply of cooling air CF to the spinning cylinder 31 at least before detachment of the cover 42. This is because, as long as the upper opening of the spinning cylinder 31 is covered with the cover 42, such a cover 42 can have the function of preventing the cooling air CF from going from the upper opening of the spinning cylinder 31 toward the spinneret 24. The step of stopping the supply of cooling air CF to the spinning cylinder 31 corresponds to the temperature decrease suppression step.

[2-2-6. Yarn threading step]

[0074] FIG. 19 depicts an example of view schematically showing a part of the spinning system 1 in a state of allowing the spinning cylinder 31 to have yarn threaded therethrough in yarn threading work. As shown in FIG. 19, after implementation of the work of detaching the cover 42 covering the upper opening of the spinning cylinder 31, the operator conducts yarn threading work of threading the molten polymer P spun from the spinneret 24 (or cooled and solidified yarn Y) through the spinning cylinder 31. At this time, since the cooling air CF is not supplied to the spinning cylinder 31, it is highly likely that the molten polymer P spun from the spinneret 24 will be in a molten state without being cooled and solidified. In response to this, the operator preferably conducts the yarn threading work using a tool such as scissors or the like.

[2-2-7. Restoration step]

[0075] FIG. 20 depicts an example of view schematically showing a part of the spinning system 1 when having caused the cooling unit 3 to move up to the upper end with respect to the spinning beam 21. After the implementation of yarn threading work, in response to operation by the operator, e.g., the controller 7 actuates the air cylinder 5 in an expanding direction to cause the cooling unit 3 to move up so as to be closer to the spinning beam 21, as shown in FIG. 20. When the lower end of the spinning beam 21 and the upper end of the cooling unit 3 abut each other, the controller 7 stops actuation of the air cylinder 5 to stop causing the cooling unit 3 to move upward.

[0076] When the lower end of the spinning beam 21 and the upper end of the cooling unit 3 abut each other and causing the cooling unit 3 to move upward is stopped, the operator stretches the yarn around the oil-agent application unit 8. After the yarn is stretched around the oil-agent application unit 8, the controller 7 restarts operation of the first compressed-air source 37 in response to op-

eration by the operator, e.g., thereby starting the supply of cooling air CF to the spinning cylinder 31, as shown in FIG. 20. Timing of stretching the yarn around the oil-agent application unit 8 is not limited to a moment after having caused the cooling unit 3 to move upward with respect to the spinning beam 21 but may coincide with a moment before causing the cooling unit 3 with respect to the spinning beam 21 is started or with a period when causing the cooling unit 3 to move upward with respect to the spinning beam 21.

[0077] While other preparations for starting production are made in the restoration step, illustrations of these other preparations are omitted. After implementation of the restoration step, the spinning system 1 works normally to be in a state of production.

[2-2-8. Effects and the like]

[0078] As described above, in the maintenance step according to an embodiment of the present invention, at least when the cooling unit 3 having been caused to move downward with respect to the spinning beam 21, the supply of cooling air CF to the spinning cylinder 31 can be stopped. As a result, the cooling air CF flowing upward from the spinning cylinder 31 is stopped. As a consequence, decrease in temperature at the spinneret 24 and in ambient temperature around the spinneret 24 can be suppressed.

[0079] As described above, in the maintenance step according to an embodiment of the present invention, stopping the supply of cooling air CF is a basis for the descriptions; however, instead of such stopping of the supply, an amount of the supplied cooling air CF to the spinning cylinder 31 may be suppressed. The suppressed amount of the cooling air CF supplied to the spinning cylinder 31 results in the suppression of an amount of the cooling air CF supplied from the upper opening of the spinning cylinder 31 to the spinneret 24, and therefore, decrease in temperature at the spinneret 24 and in ambient temperature around the spinneret 24 can be suppressed. Thus, time for temperature at the spinneret 24 and ambient temperature around the spinneret 24 to recover their original temperatures can be shortened after restoration to a working state to allow reduction in the amount of yarn to be disposed of.

[0080] While the maintenance step according to an embodiment of the present invention is as has been described above, this is not the only maintenance step for solving the problem revealed in the conventional maintenance step. The following describes a maintenance step according to a modification.

[2-3. Maintenance step according to modified embodiment of present invention]

[0081] The maintenance step according to the modification will be described by referring to FIGS. 21 to 27. The state of the spinning system 1 during production or

in a working state is the same as that of FIG. 1, so that a drawing showing the state of the spinning system 1 in a working state is omitted.

[0082] The maintenance step according to the modification largely differs from the maintenance step according to an embodiment of the present invention in that the supply of side air SF to a working space Sw formed in an up-and-down direction between the spinning unit 2 and the cooling unit 3 at least during causing the cooling unit 3 to move downward with respect to the spinning beam 21. It is to be noted that a modified embodiment of the present invention and an embodiment of the present invention are the same as each other in that the cooling air CF is not supplied to the spinning cylinder 31 in the maintenance step.

[0083] As shown in FIG. 1, while the spinning system 1 is in operation, the lower end of the spinning beam 21 and the upper end of the cooling unit 3 are in abutting contact with each other. While the spinning system 1 is in operation, the molten polymer P is spun from the spinneret 24 and the cooling air CF is supplied from the first compressed-air source 37 to the spinning cylinder 31 through the duct 32 (see FIG. 4). The cooling air CF supplied to the spinning cylinder 31 flows in a substantially horizontal direction into the hollow area CE to cool the molten polymer P spun from the spinneret 24. While the spinning system 1 is in operation, the side air SF is not released from the air nozzle 62.

[2-3-1. Preparation step]

[0084] FIG. 21 depicts an example of view schematically showing a part of the spinning system 1 in a state of stopping the spinning of molten polymer P. For implementation of maintenance on the spinning system 1, the spinning of the molten polymer P from the spinneret 24 is stopped first, as shown in FIG. 21. The spinning of the molten polymer P is stopped by the controller 7 in response to operation by, e.g., an operator. The blower 6 stops its operation and air is not supplied from the second compressed-air source 66 to the air nozzle 62, so that the side air SF is not released from the air nozzle 62.

[0085] After stopping the spinning of the molten polymer P, the controller 7 stops operation of the first compressed-air source 37 to stop supply of the cooling air CF to the spinning cylinder 31. Stopping supply of the cooling air CF to the spinning cylinder 31 makes it possible to prevent the cooling air CF from going from the upper opening of the spinning cylinder 31 toward the spinneret 24, thereby preventing serious decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24.

[0086] FIG. 22 depicts an example of view schematically showing a part of the spinning system 1 in a state of having caused the cooling unit 3 to move down to a lower end with respect to the spinning beam 31. After stopping supply of the cooling air CF to the spinning cylinder 31, the controller 7 actuates the air cylinder 5 in a

contracting direction to lower the cooling unit 3 with respect to the spinning beam 21, as shown in FIG. 22. Causing the cooling unit 3 to move down with respect to the spinning beam 21 forms the working space Sw between the spinning unit 2 and the cooling unit 3 as viewed in an up-and-down direction. When the cooling unit 3 is caused to move down with respect to the spinning beam 21, the operator conducts work of covering the upper opening of the spinning cylinder 31 with the cover 42. However, it is not necessarily required to conduct the work of covering the upper opening of the spinning cylinder 31 with the cover 42 as supply of the cooling air CF to the spinning cylinder 31 is stopped. The blower 6 stops its operation and compressed air is not supplied from the second compressed-air source 66 to the air nozzle 62, so that the side air SF is not released from the air nozzle 62.

[0087] Preferably, timing of stopping the spinning of the molten polymer P coincides with a moment before start of causing the cooling unit 3 to move down with respect to the spinning beam 21. However, this is not the only timing but the spinning may be stopped during causing the cooling unit 3 with respect to the spinning beam 21 or after causing the cooling unit 3 to move down to the lower end with respect to the spinning beam 21.

[0088] Timing of stopping supply of the cooling air CF to the spinning cylinder 31 is not limited to a moment after the spinning of the molten polymer P is stopped but may coincide with a moment before the spinning of the molten polymer P is stopped or with a moment substantially simultaneous with stop of the spinning of the molten polymer P.

[2-3-2. Maintenance main step]

[0089] After the cooling unit 3 has been caused to move down with respect to the spinning beam 21 and the upper opening of the spinning cylinder 31 is covered with the cover 42 while this covering is not absolute necessity, the operator conducts the maintenance such as surface cleaning of the spinneret 24 or exchange of the spinning pack 23 in response to purpose. While time required for the maintenance is determined in a manner that depends on the detail of the maintenance, it is generally 10 minutes.

[2-3-3. Molten polymer spinning restarting step]

[0090] FIG. 23 depicts an example of view schematically showing a part of the spinning system 1 in a state of restarting the spinning of molten polymer P. After implementation of the maintenance, in response to operation by the operator, e.g., the controller 7 starts (restarts) the spinning of the molten polymer P from the spinneret 24, as shown in FIG. 23. If the upper opening of the spinning cylinder 31 is covered with the cover 42, the operator conducts work of detaching the cover 42 covering the upper opening of the spinning cylinder 31.

[2-3-4. Temperature decrease suppression step]

[0091] The foregoing step of stopping supply of the cooling air CF to the spinning cylinder 31 is included in a temperature decrease limiting step. Timing of stopping supply of the cooling air CF to the spinning cylinder 31 is as has been described above. If the upper opening of the spinning cylinder 31 is covered with the cover 42, however, it is only required to stop supply of the cooling air CF to the spinning cylinder 31 at least before detachment of the cover 42. The reason for this is that, while the upper opening of the spinning cylinder 31 is covered with the cover 42, the cover 42 can function to prevent the cooling air CF from going from the upper opening of the spinning cylinder 31 toward the spinneret 24.

[0092] FIG. 24 depicts an example of view schematically showing a part of the spinning system 1 in a state of causing the cooling unit 3 to start operation. After re-starting the spinning of the molten polymer P, the controller 7 starts operation of the blower 6. When the operation of the cooling unit 3 is started, the side air SF is released in the working space Sw between the spinning unit 2 and the cooling unit 3 as viewed in an up-and-down direction from the air nozzle 62 in a substantially horizontal direction toward the molten polymer P spun from the spinneret 24. A step of releasing the side air SF in the working space Sw from the air nozzle 62 is also included in the temperature decrease limiting step.

[0093] Operation of the blower 6 may be started after detachment of the cover 42 covering the upper opening of the spinning cylinder 31 or before detachment of the cover 42 covering the upper opening of the spinning cylinder 31. At this time, as there is no supply of the cooling air CF to the spinning cylinder 31, serious decrease in temperature at the spinneret 24 and ambient temperature around the spinneret 24 can be suppressed by the cooling air CF going upward from the upper opening of the spinning cylinder 31.

[0094] Timing of starting operation of the blower 6 is not limited to a moment after the spinning of the molten polymer P is restarted but may coincide with a moment before the spinning of the molten polymer P from the spinneret 24 is restarted.

[0095] As described above, stopping supply of the cooling air CF to the spinning cylinder 31 makes it possible to limit decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24. On the other hand, stopping supply of the cooling air CF to the spinning cylinder 31 makes it impossible to cool and solidify the molten polymer P spun from the spinneret 24 using the cooling air CF supplied to the spinning cylinder 31. Not cooling and solidifying the molten polymer P spun from the spinneret 24 might impose difficulty in conducting yarn threading through the spinning cylinder 31 after the maintenance is finished. In this regard, releasing the side air SF in the working space Sw from the air nozzle 62 toward the molten polymer P spun from the spinneret 24 allows cooling and solidification of the molten polymer

P spun from the spinneret 24. As a result, it becomes possible to facilitate yarn threading through the spinning cylinder 31 conducted after the maintenance is finished while limiting decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24.

[2-3-5. Yarn threading step]

[0096] FIG. 25 depicts an example of view schematically showing a part of the spinning system 1 in a state of allowing the spinning cylinder 31 to have yarn threaded therethrough in yarn threading work. As shown in FIG. 25, when release of the side air SF from the air nozzle 62 is started, the operator conducts yarn threading work of threading the molten polymer P spun from the spinneret 24 (or cooled and solidified yarn Y) through the spinning cylinder 31. At this time, the molten polymer P spun from the spinneret 24 is cooled and solidified by the side air SF released from the air nozzle 62. This allows the operator to conduct the yarn threading work without using a tool.

[2-3-6. Restoration step]

[0097] FIG. 26 depicts an example of view schematically showing a part of the spinning system 1 in a state of having caused the cooling unit 3 to move up to the upper end with respect to the spinning beam 21. As shown in FIG. 26, after implementation of the work of threading the yarn through the spinning cylinder 31, in response to operation by the operator, e.g., the controller 7 actuates the air cylinder 5 in an expanding direction to cause the cooling unit 3 to move up so as to make the cooling unit 3 get closer to the spinning beam 21. When the spinning beam 21 and the cooling unit 3 abut each other, the controller 7 stops actuation of the air cylinder 5 to stop elevation of the cooling unit 3. Furthermore, when the spinning beam 21 and the cooling unit 3 abut each other and elevation of the cooling unit 3 is stopped, the controller 7 stops operation of the blower 6 to stop release of the side air SF from the air nozzle 62 so as to finish the air blowing step. Preferably, timing of stopping release of the side air SF from the air nozzle 62 coincides with a moment when the spinning beam 21 and the cooling unit 3 abut each other and elevation of the cooling unit 3 is stopped or a moment after stop of the elevation, as it allows cooling and solidification of the molten polymer P spun from the spinneret 24. In another case, release of the side air SF from the air nozzle 62 may be stopped before elevation of the cooling unit 3 with respect to the spinning beam 21 is started or during elevation of the cooling unit 3 so as to make the cooling unit 3 get closer to the spinning beam 21. The abutting contact between the spinning beam 21 and the cooling unit 3 closes the upper opening of the spinning cylinder 31 to cause the cooling air CF flowing into the hollow area CE to go downward entirely or mostly. Thus, it is still possible to suppress decrease in temperature at the spinneret 24

and in ambient temperature around the spinneret 24 even after the air blowing step is finished. As a result, it becomes possible to shorten time for a temperature at the spinneret 24 and an ambient temperature around the spinneret 24 to restore their respective original levels, eventually, shorten time for stabilizing the physical properties of yarn.

[0098] After elevation of the cooling unit 3 with respect to the spinning beam 21 is stopped, the operator stretches the yarn around the oil applicator 8. Timing of stretching the yarn around the oil applicator 8 is not limited to a moment after the cooling unit 3 has been caused to move up with respect to the spinning beam 21 but may coincide with a moment before elevation of the cooling unit 3 with respect to the spinning beam 21 is started or with a period when the cooling unit 3 is being caused to move up with respect to the spinning beam 21. However, this timing preferably coincides with a moment after release of the side air SF from the air nozzle 62 is stopped.

[0099] FIG. 27 depicts an example of view schematically showing a part of the spinning system 1 in a state of being restored to an operational state. When the lower end of the spinning beam 21 and the upper end of the cooling unit 3 abut each other and elevation of the cooling unit 3 is stopped, the controller 7 restarts operation of the first compressed-air source 37 to start supply of the cooling air CF to the spinning cylinder 31.

[0100] While other preparations for starting production are made in the restoration step, illustrations of these other preparations are omitted. After implementation of the restoration step, the spinning system 1 works normally to be in a state of production.

[0101] Timing of starting supply of the cooling air CF to the spinning cylinder 31 is not limited to a moment when the lower end of the spinning beam 21 and the upper end of the cooling unit 3 abut each other and elevation of the cooling unit 3 is stopped. For example, if the side air SF released from the air nozzle 62 flows between the spinning unit 2 and the cooling unit 3 as viewed in an up-and-down direction, supply of the cooling air CF to the spinning cylinder 31 may be started while the cooling unit 3 is at the lower end. Starting supply of the cooling air CF to the spinning cylinder 31 while the cooling unit 3 is at the lower end makes it likely that the cooling air CF will flow from the upper opening of the spinning cylinder 31 toward the spinneret 24. However, as the side air SF released from the air nozzle 62 functions as a barrier, it is possible to limit decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24.

[2-3-7. Effects and the like]

[0102] In the maintenance step according to the modification described above, at least in a state where the cooling unit 3 has been moved downward with respect to the spinning beam 21, supply of the cooling air CF to the spinning cylinder 31 is stopped. This allows the cool-

ing air CF to be stopped from flowing from the upper opening of the spinning cylinder 31 toward the spinneret 24. As a result, it is possible to limit decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24.

[0103] The foregoing maintenance step according to the modification has been described on the assumption that supply of the cooling air CF to the spinning cylinder 31 is stopped. However, instead of stopping supply of the cooling air CF to the spinning cylinder 31, the air volume of the cooling air CF to be supplied to the spinning cylinder 31 may be reduced. Reducing the air volume of the cooling air CF to be supplied to the spinning cylinder 31 reduces the air volume of the cooling air CF to flow from the upper opening of the spinning cylinder 31 toward the spinneret 24, making it possible to limit decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24. Regarding reduction in the air volume of the cooling air CF to be supplied to the spinning cylinder 31, this air volume may be reduced at least compared to an air volume during production, namely, before stop of the spinning of the molten polymer P.

[0104] Stopping supply of the cooling air CF to the spinning cylinder 31 or reducing the volume of supply of the cooling air CF during implementation of maintenance on the spinning system 1 might result in the failure to cool and solidify the molten polymer P spun from the spinneret 24 to impose difficulty in the work of threading yarn through the spinning cylinder 31 conducted after the maintenance is finished. However, as the side air SF released from the air nozzle 62 flows toward a direction intersecting a yarn path of the molten polymer P spun from the spinneret 24, it is possible to cool and solidify the molten polymer P spun from the spinneret 24. This allows yarn threading through the spinning cylinder to be conducted easily after the maintenance is finished while limiting decrease of temperature at the spinneret 24 and ambient temperature around the spinneret 24. As a result, after restoration is made to a working state, it becomes possible to shorten time for temperature at the spinneret 24 and ambient temperature around the spinneret 24 to recover their original temperatures to allow reduction in the amount of yarn to be disposed of.

[3. Verification Result of Maintenance Step of Present Invention and Modification]

[0105] As a result of implementation of maintenance by the maintenance step according to the present invention or implementation of maintenance by the maintenance step according to the modification described above, it was possible to shorten time required to recover normal physical properties of yarn after restoration to a working state. FIG. 28 is a schematic view showing result about circular knit staining evaluation that is changed with passage of time from restoration to a working state after implementation of maintenance by the maintenance step according to the present invention. FIG. 29 is a graph

showing an example of result about thermal stress and de-twisting tension on yarn that are changed with passage of time from restoration to a working state in each of a case where maintenance is conducted by the conventional maintenance step and a case where maintenance is conducted by the maintenance step according to the modification.

[0106] As shown in FIG. 28, in the result about circular knit staining evaluation, a color approximate to B. M is obtained roughly after 15 minutes from restoration to a working state so the yarn is determined to be normal. In this way, it was possible to shorten time considerably required for the yarn to be determined to be normal, compared to implementation of the maintenance by the conventional maintenance step.

[0107] As clearly understood from FIG. 29, both the de-twisting tension and the thermal stress fulfill more favorable results in the case of implementation of maintenance by the maintenance step of the modification than in the case of implementation of maintenance by the conventional maintenance step.

[0108] FIG. 30 is a graph showing change in surface temperature on the spinneret 24 responsive to passage of time from when maintenance is started by each of the conventional maintenance step, the maintenance step of the present invention, and the maintenance step of the modification. In FIG. 30, (a) shows exemplary change in surface temperature on the spinneret 24 responsive to passage of time from when the maintenance is started by the conventional maintenance step. In FIG. 30, (b) shows exemplary change in surface temperature on the spinneret 24 responsive to passage of time from when the maintenance is started by the maintenance step according to the present invention. In FIG. 30, (c) shows exemplary change in surface temperature on the spinneret 24 responsive to passage of time from when the maintenance is started by the maintenance step according to the modification.

[0109] It is understood from FIG. 30 that surface temperature on the spinneret 24 decreases in response to cause the cooling unit 3 to move down with respect to the spinning beam 21 during implementation of each of the conventional maintenance step, the maintenance step of the present invention, and the maintenance step of the modification. After the maintenance is finished and the cooling unit 3 is caused to move up, however, time required for surface temperature on the spinneret 24 to recover its original temperature is shorter in the case of implementation of each of the maintenance step of the present invention and the maintenance step of the modification than in the case of implementation of the conventional maintenance step. Possible reason for this is that, if the maintenance is conducted by the conventional maintenance step, temperature at the spinneret 24 and ambient temperature around the spinneret 24 decrease seriously with the cooling air CF going upward from the upper opening of the spinning cylinder 31 in causing the cooling unit 3 to move up. In this regard, according to the

maintenance step of an embodiment of the present invention, the cooling air CF is not supplied to the spinning cylinder 31. This results in the absence of the cooling air CF itself to go upward from the upper opening of the spinning cylinder 31 or reduces the air volume of the cooling air CF to go upward from the upper opening of the spinning cylinder 31, thereby allowing limitation on decrease of surface temperature on the spinneret 24. Further, according to the maintenance step of a modified embodiment of the present invention, while the cooling air CF supplied to the spinning cylinder 31 goes upward, this cooling air CF is blocked by the side air SF released from the air nozzle 62 of the cooling unit 3, thereby allowing limitation on decrease of surface temperature on the spinneret 24.

(Reference Numerals)

[0110]

1	Spinning system
3	Cooling unit
5	Air cylinder
6	Blower
7	Controller
21	Spinning beam
23	Spinning pack
24	Spinneret
31	Spinning cylinder
P	Molten polymer
CF	Cooling air
Sw	Working space

Claims

1. A spinning system (1) comprising:

a spinning beam (21) having a spinning pack (23) inserted therein including a spinneret (24) for allowing molten polymer (P) to be spun downward;

a cooling unit (3) arranged below the spinning beam (21), including a spinning cylinder (31) extending in an up-and-down direction so as to surround the molten polymer (P) spun from the spinneret (24), configured to cool the molten polymer (P) through the use of cooling air (CF) supplied from a periphery of the spinning cylinder (31);

a moving mechanism (5) configured to cause the cooling unit (3) to move downward with respect to the spinning beam (21) so as to form a gap between the cooling unit (3) and the spinning beam (21); and

temperature decrease suppression means configured to, at least when the cooling unit (3) having been caused to move downward with respect

- to the spinning beam (21), suppress decrease in temperature at the spinneret (24).
2. The spinning system (1) as claimed in claim 1, wherein
- the temperature decrease suppression means includes
- a controller (7) configured to control at least supply of cooling air (CF) to the spinning cylinder (31), wherein the controller (7) is capable of exerting:
- control for stopping supply of cooling air (CF) to the spinning cylinder (31); or
- control for suppressing supply, to the spinning cylinder (31), of cooling air (CF) in amount in comparison with a state before spinning of the molten polymer (P) is stopped,
- at least when the cooling unit (3) having been caused to move downward with respect to the spinning beam (21).
3. The spinning system (1) as claimed in claim 2, wherein
- the temperature decrease suppression means further includes
- a blower (6) configured to blow air toward between the spinning beam (21) and the cooling unit (3) in a direction intersecting a yarn path of the molten polymer (P) spun from the spinneret (24).
4. The spinning system (1) as claimed in claim 3, wherein
- the blower (6) stops operation when the spinning beam (21) and the cooling unit (3) abut each other.
5. A method of controlling a spinning system (1) comprising:
- a spinning beam (21) having a spinning pack (23) inserted therein including a spinneret (24) for allowing molten polymer (P) to be spun downward; and
- a cooling unit (3) arranged below the spinning beam (21), including a spinning cylinder (31) extending in an up-and-down direction so as to surround the molten polymer (P) spun from the spinneret (24), configured to cool the molten polymer (P) through the use of cooling air (CF) supplied from a periphery of the spinning cylinder (31),
- wherein said spinning system (1) performs:
- a preparation step of causing the cooling
- unit (3) to move downward with respect to the spinning beam (21) so as to form a gap between the cooling unit (3) and the spinning beam (21);
- a temperature decrease suppression step of suppressing decrease in temperature at the spinneret (24) at least when the cooling unit (3) having been caused to move downward with respect to the spinning beam (21); and
- a restoration step of causing the cooling unit (3) to move upward with respect to the spinning beam (21) while suppressing decrease in temperature at the spinneret (24) after the cooling unit (3) having been caused to move downward with respect to the spinning beam (21) so as to undergo maintenance.
6. The method as claimed in claim 5, wherein the temperature decrease suppression step includes:
- a step of stopping supply of cooling air (CF) to the spinning cylinder (31); or
- a step of suppressing supply, to the spinning cylinder (31), of cooling air (CF) in amount in comparison with a state before the preparation step is performed.
7. The method as claimed in claim 6, wherein the temperature decrease suppression step further includes:
- an air blowing step of blowing air toward between the spinning beam (21) and the cooling unit (3) in a direction intersecting a yarn path of the molten polymer (P) spun from the spinneret (24).
8. The method as claimed in claim 7, wherein, in the air blowing step, blowing air is finished, during performance of the restoration step, after having undergone maintenance, or when the restoration step having been finished.

FIG. 1

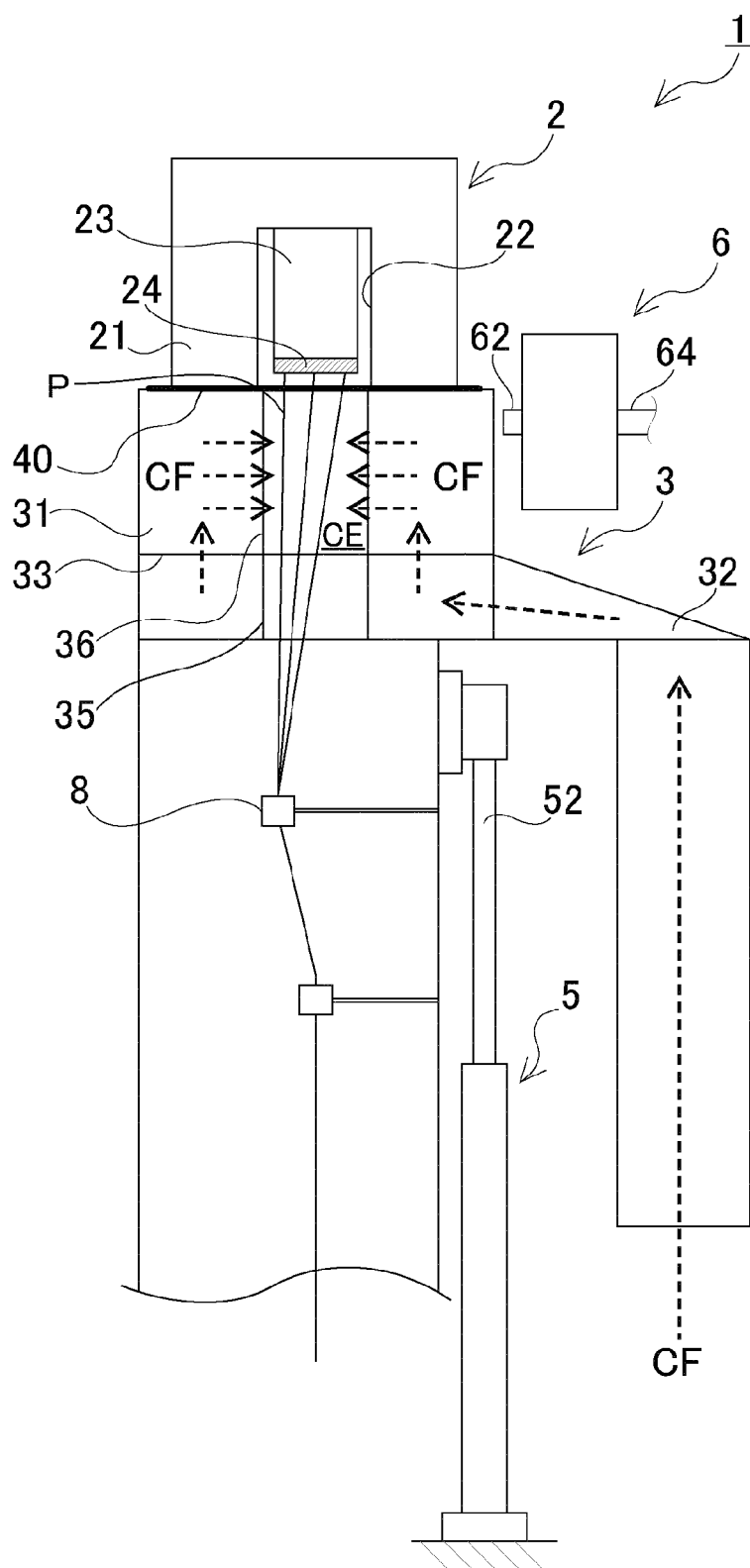


FIG. 2

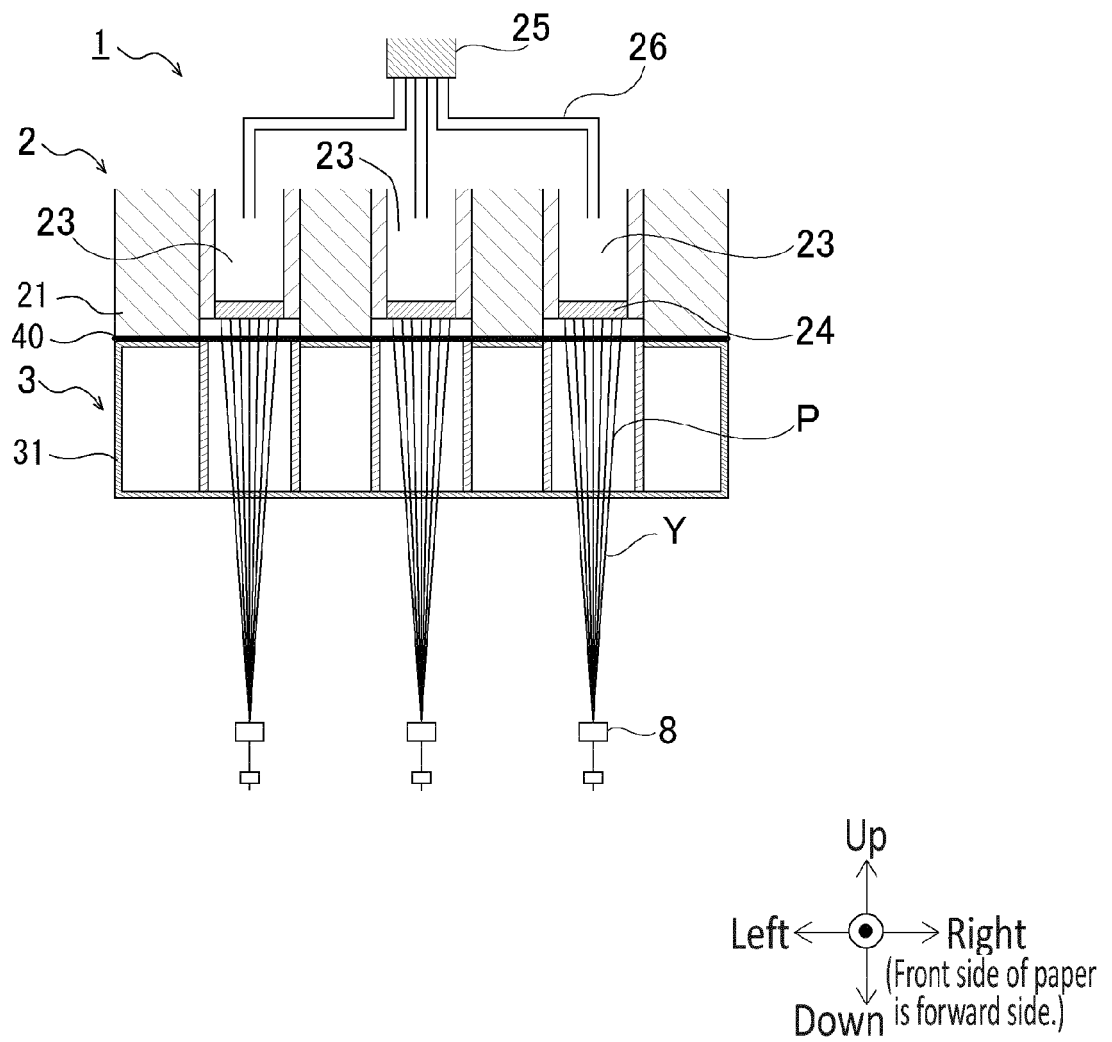


FIG. 3

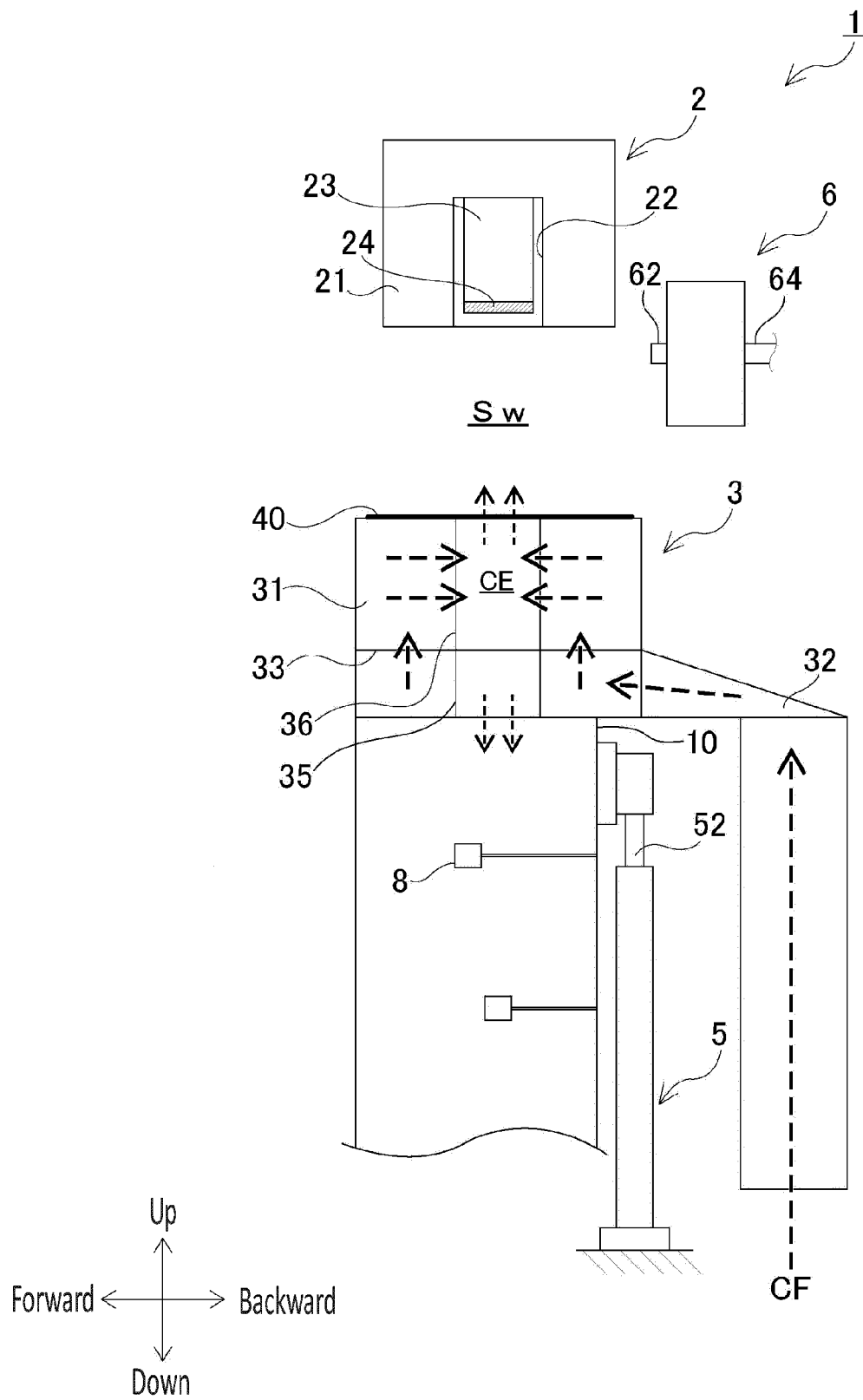


FIG. 4

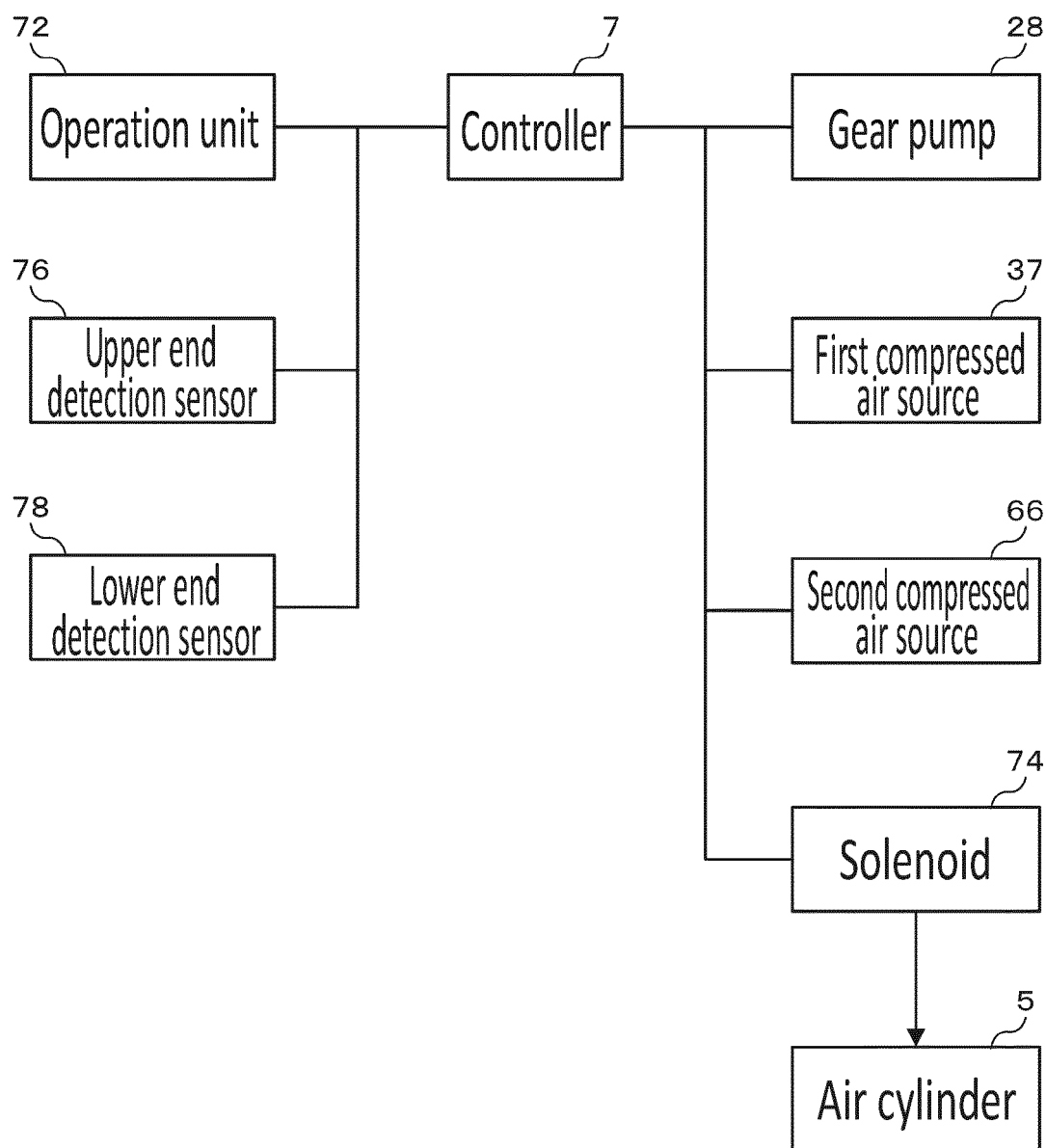


FIG. 5

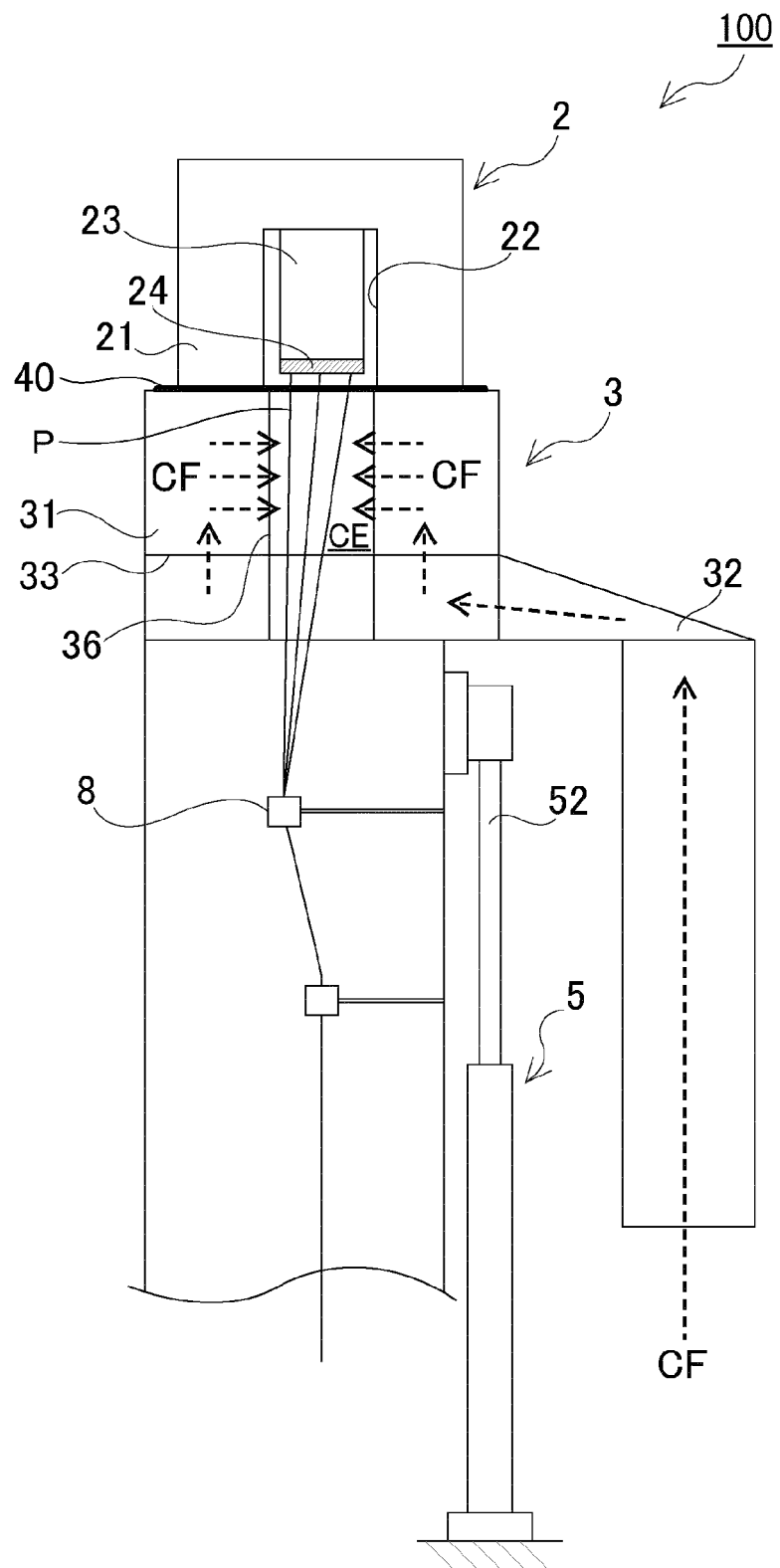


FIG. 6

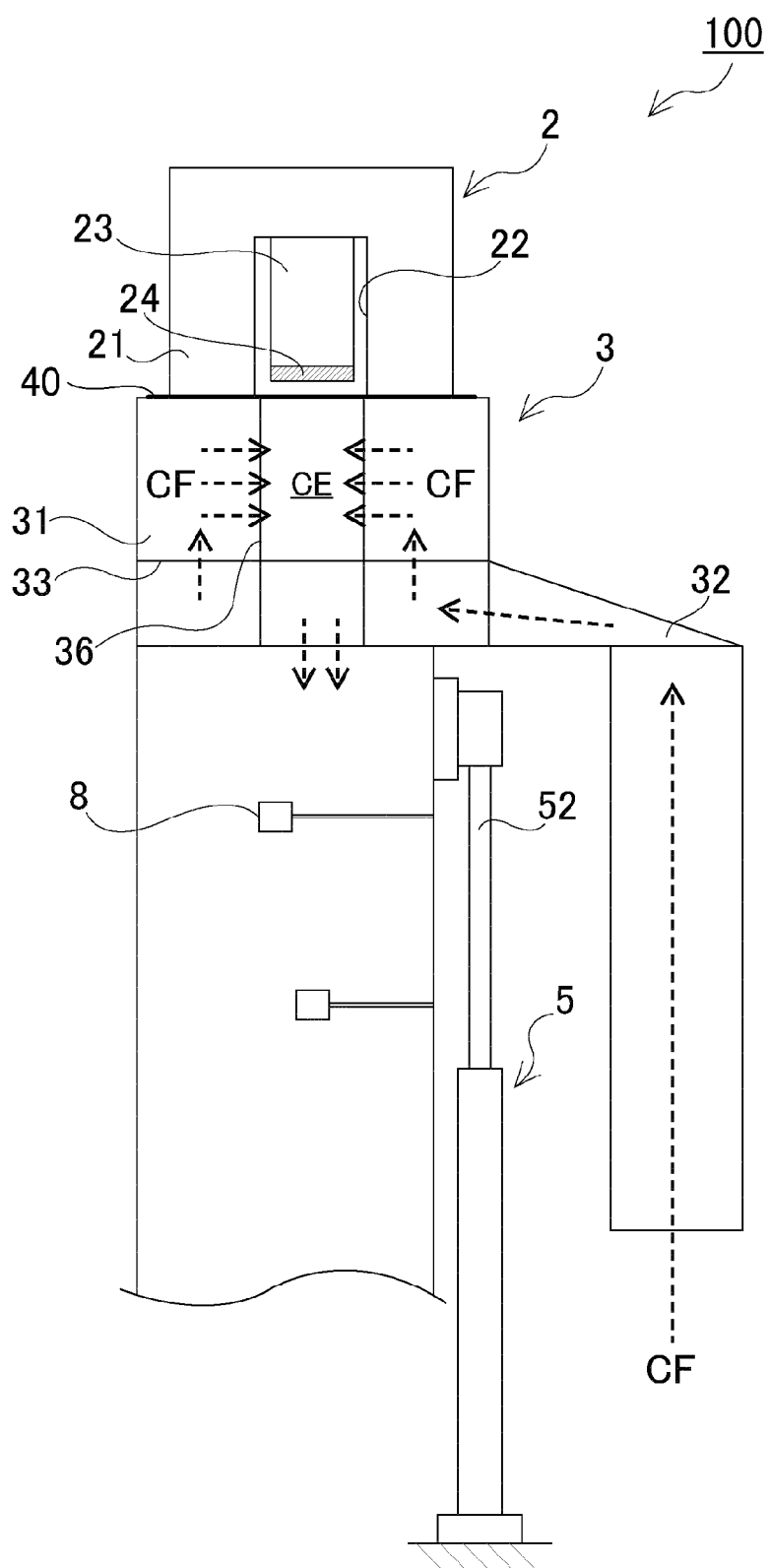


FIG. 7

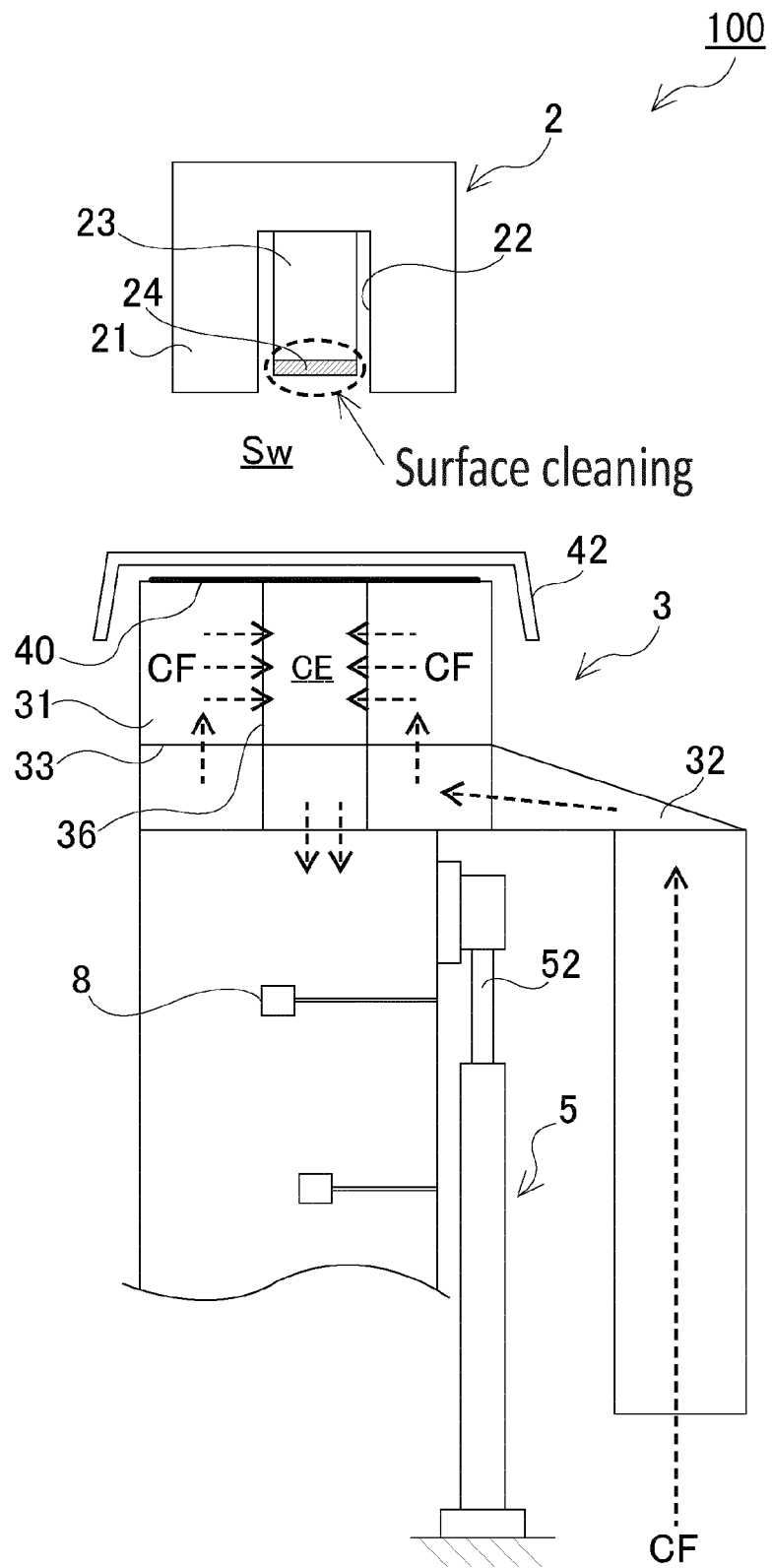


FIG. 8

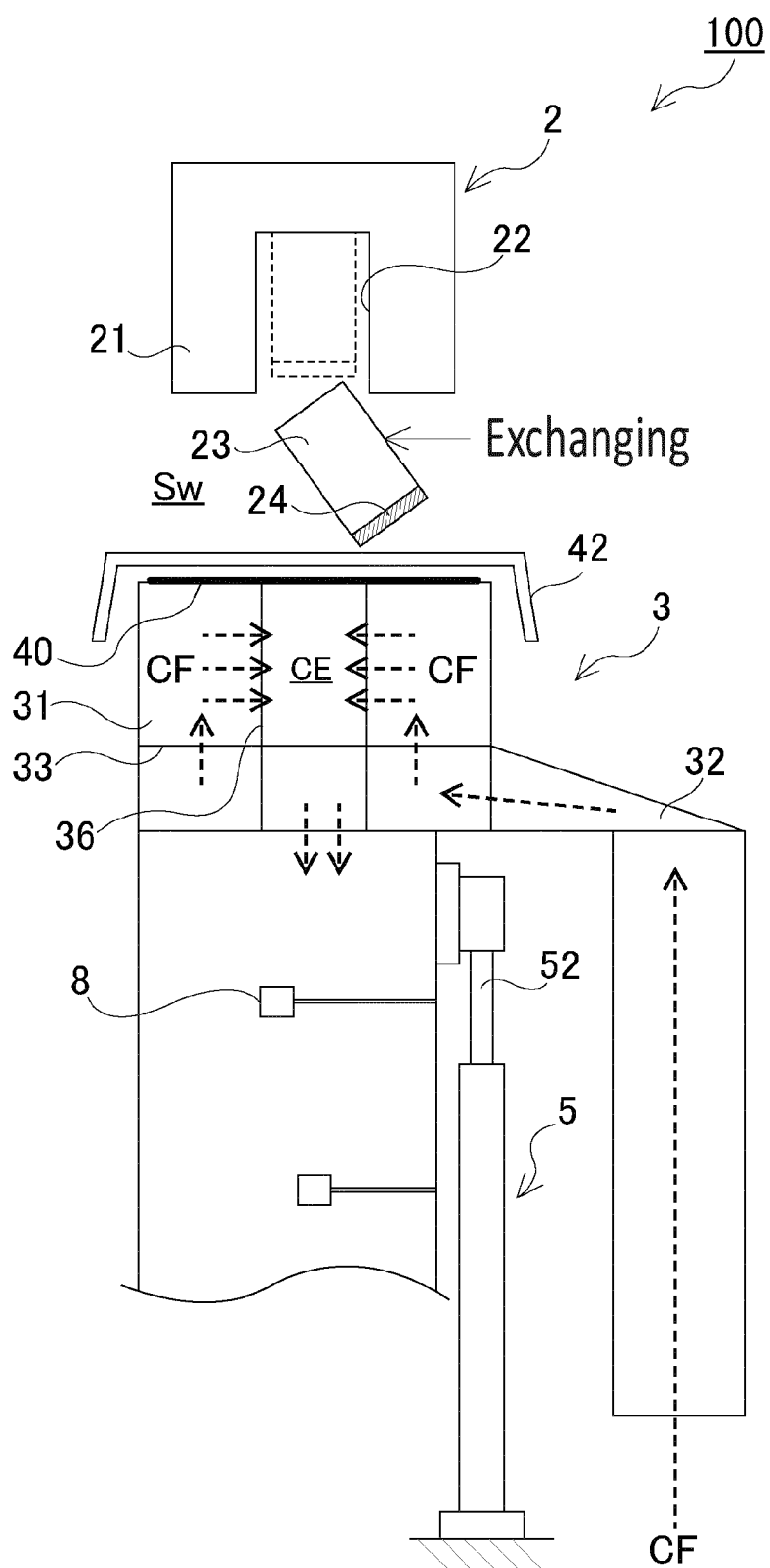


FIG. 9

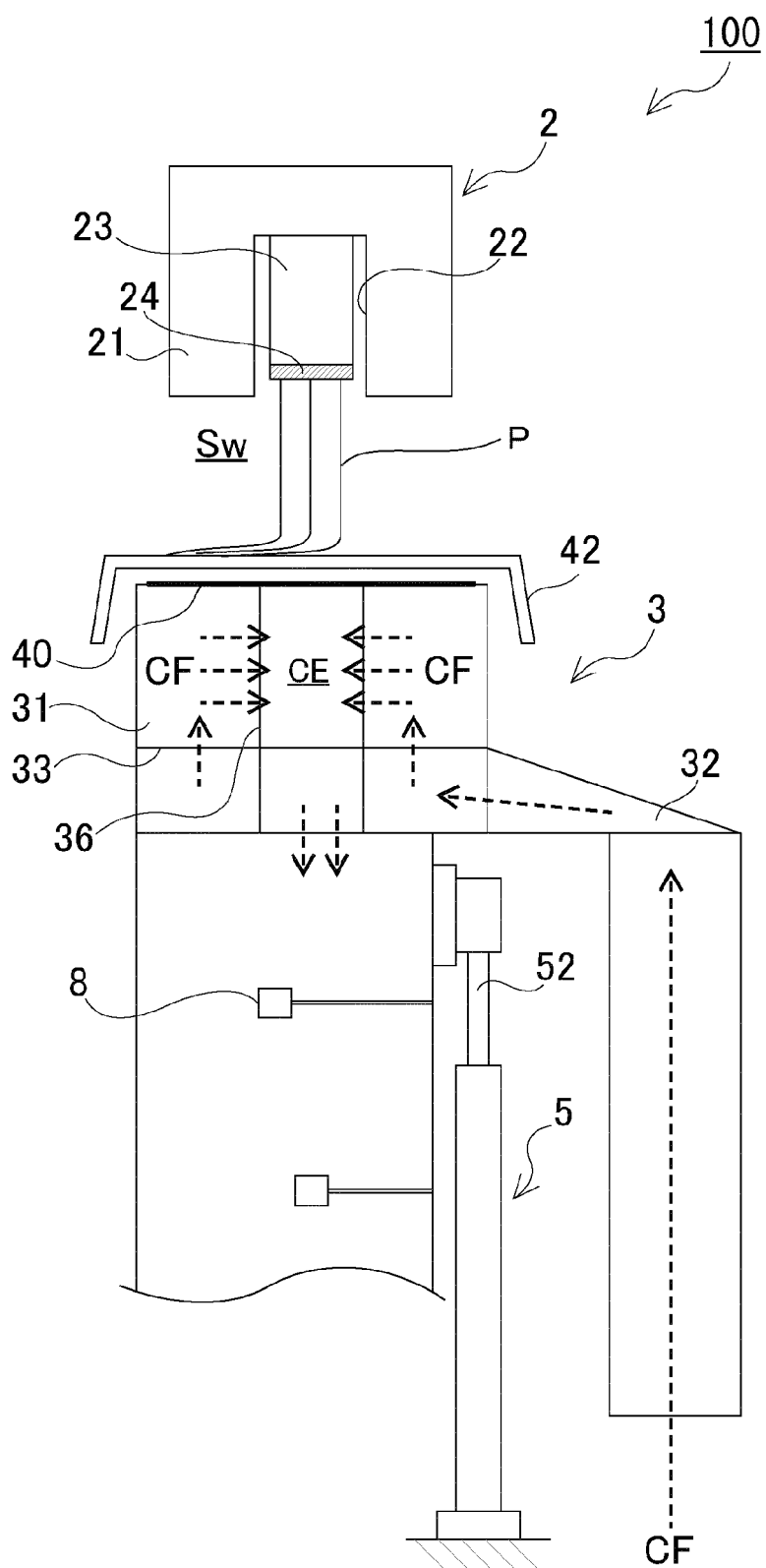


FIG. 10

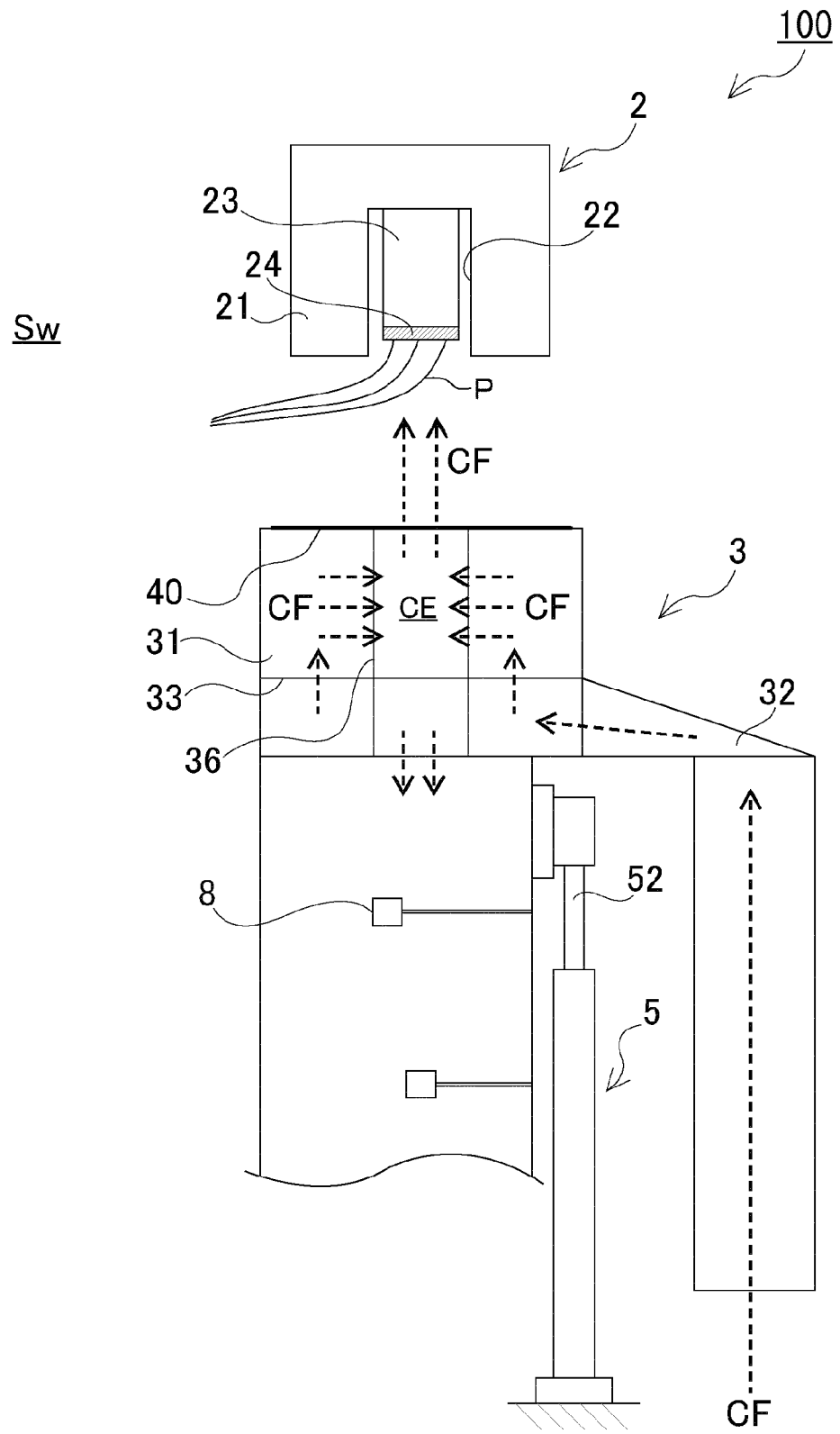


FIG. 11

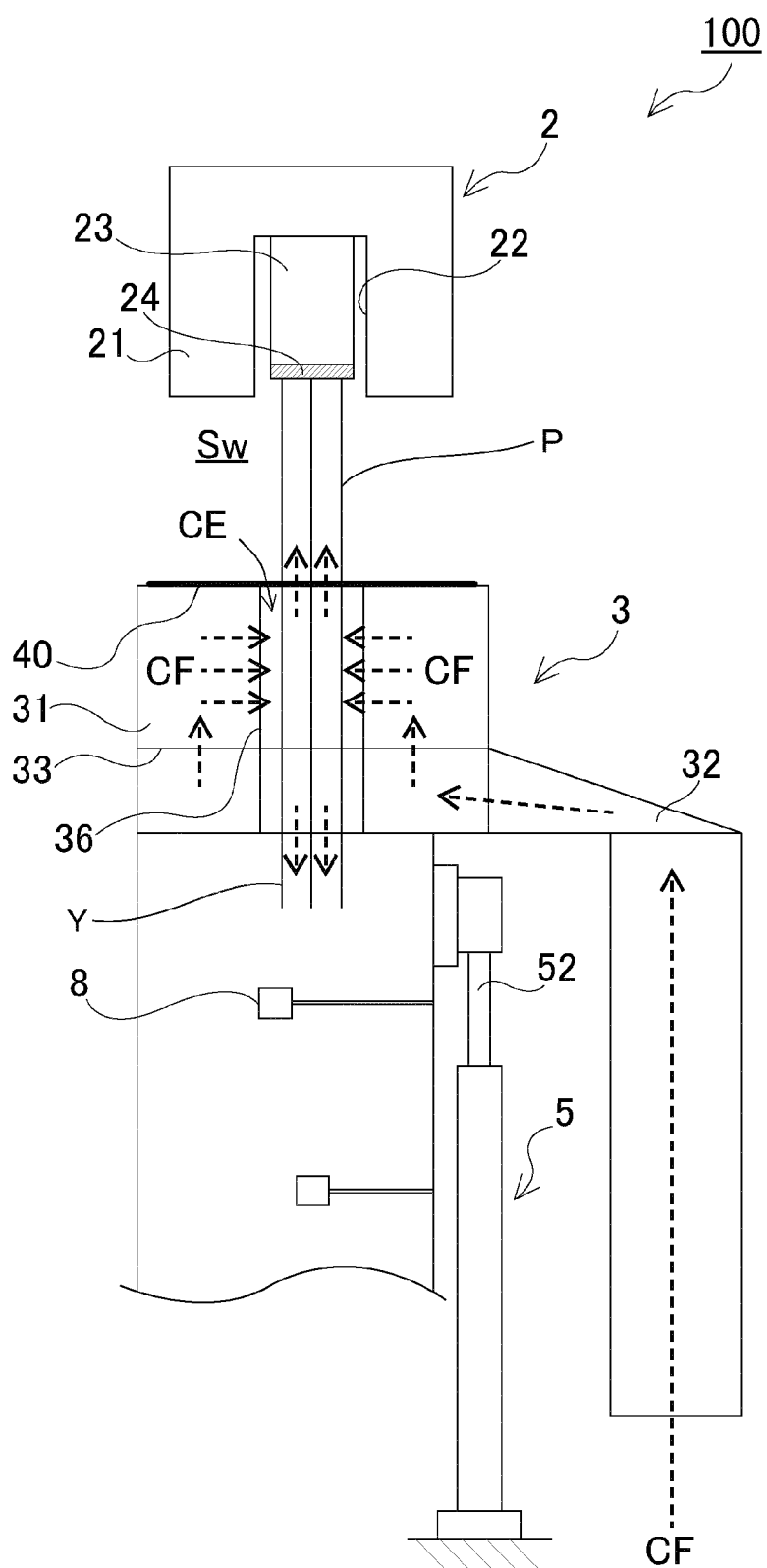


FIG. 12

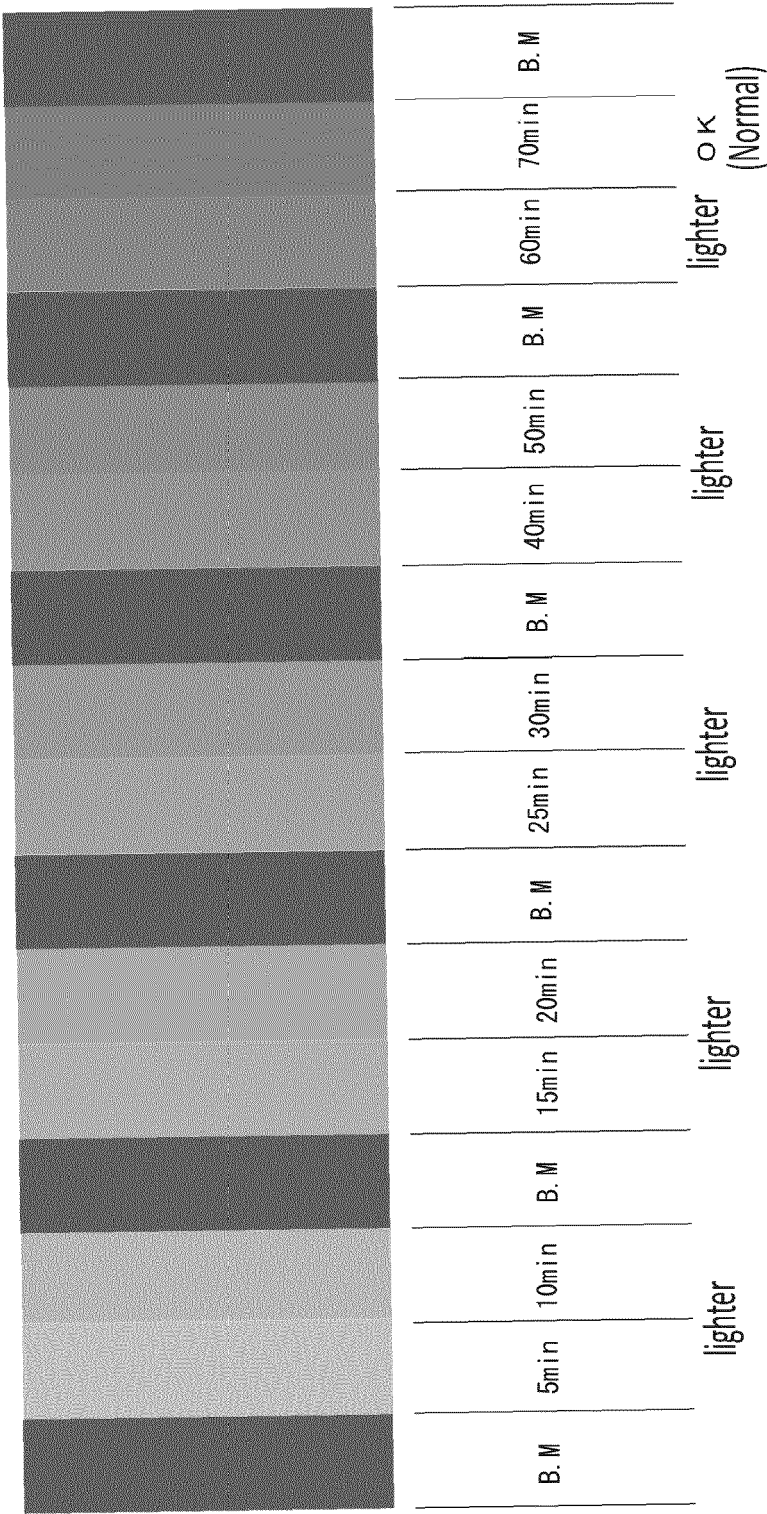


FIG. 13

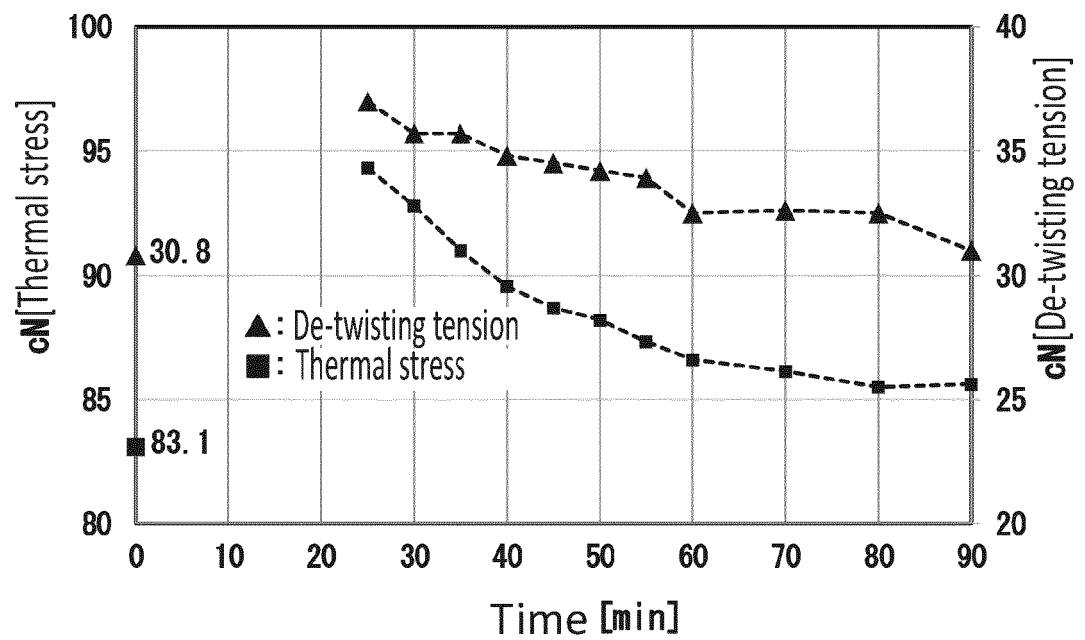


FIG. 14

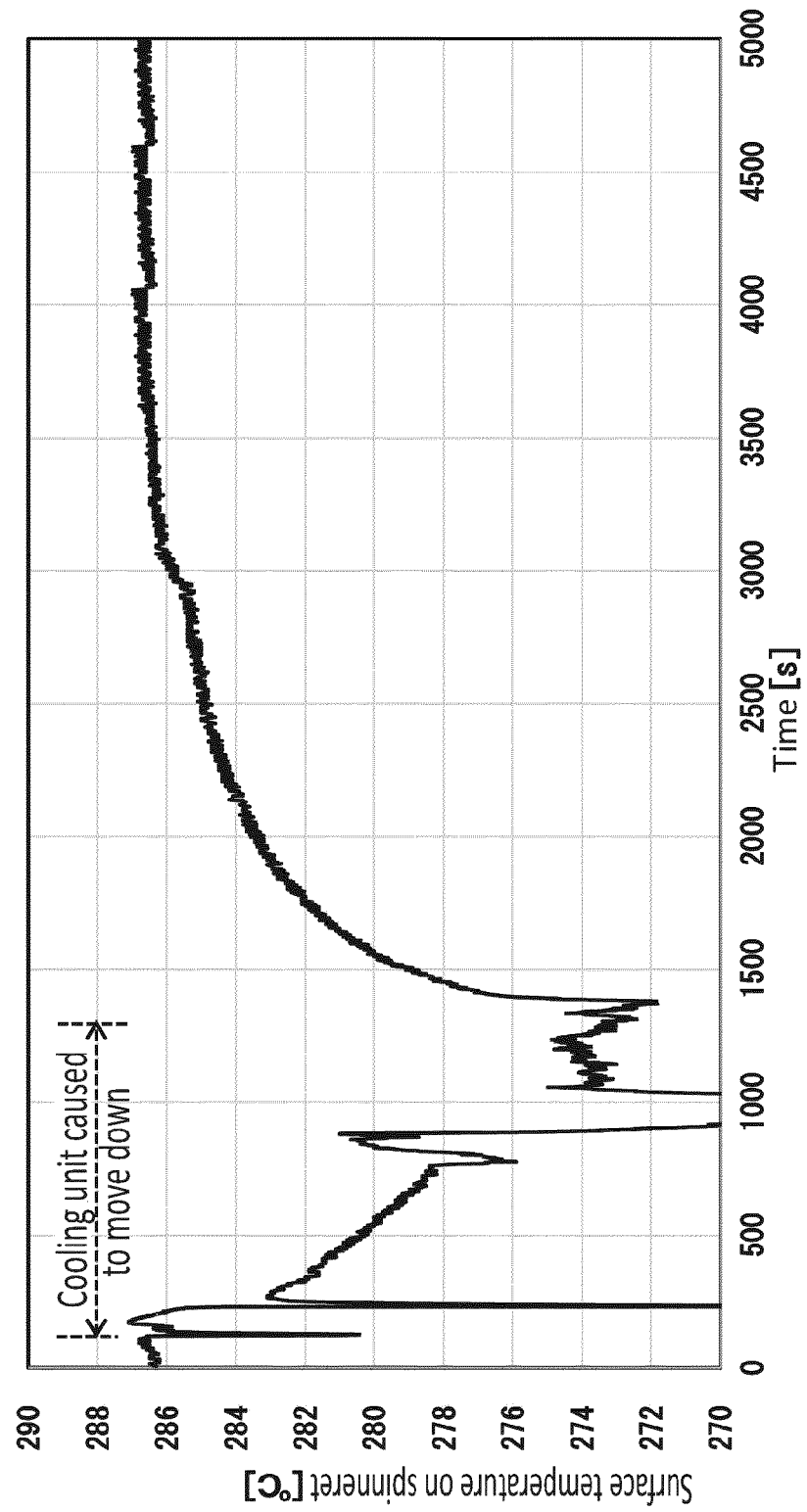


FIG. 15

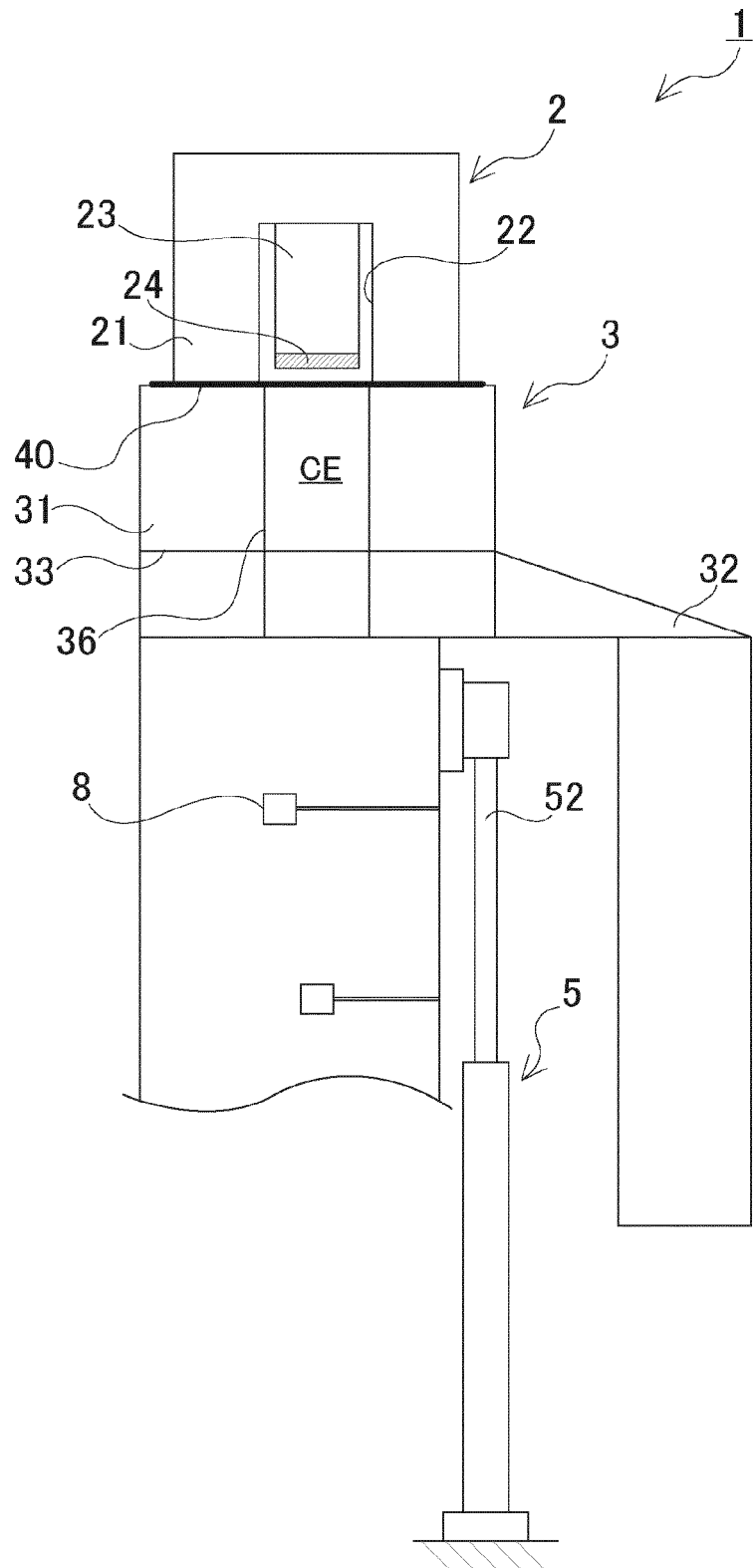


FIG. 16

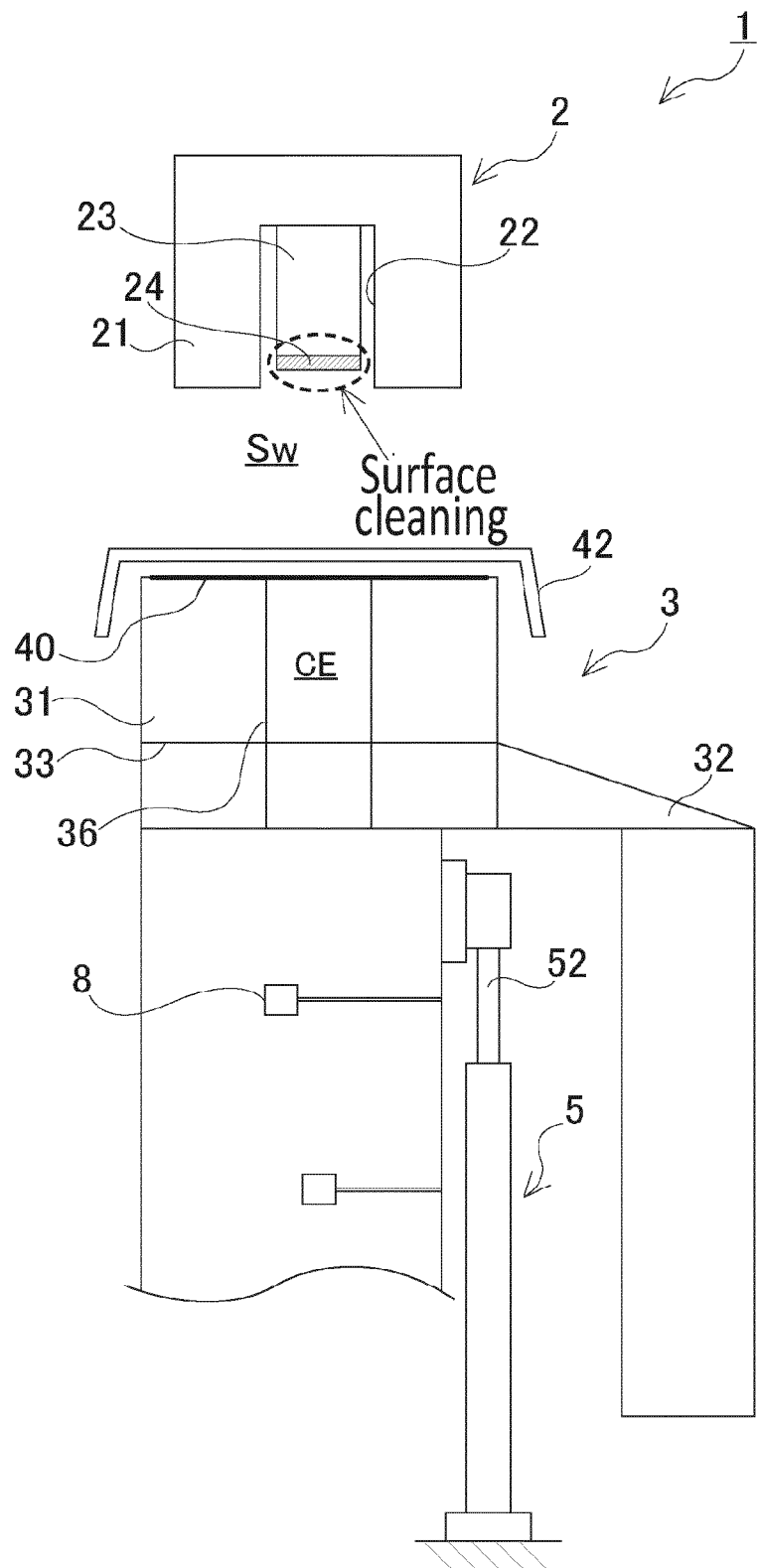


FIG. 17

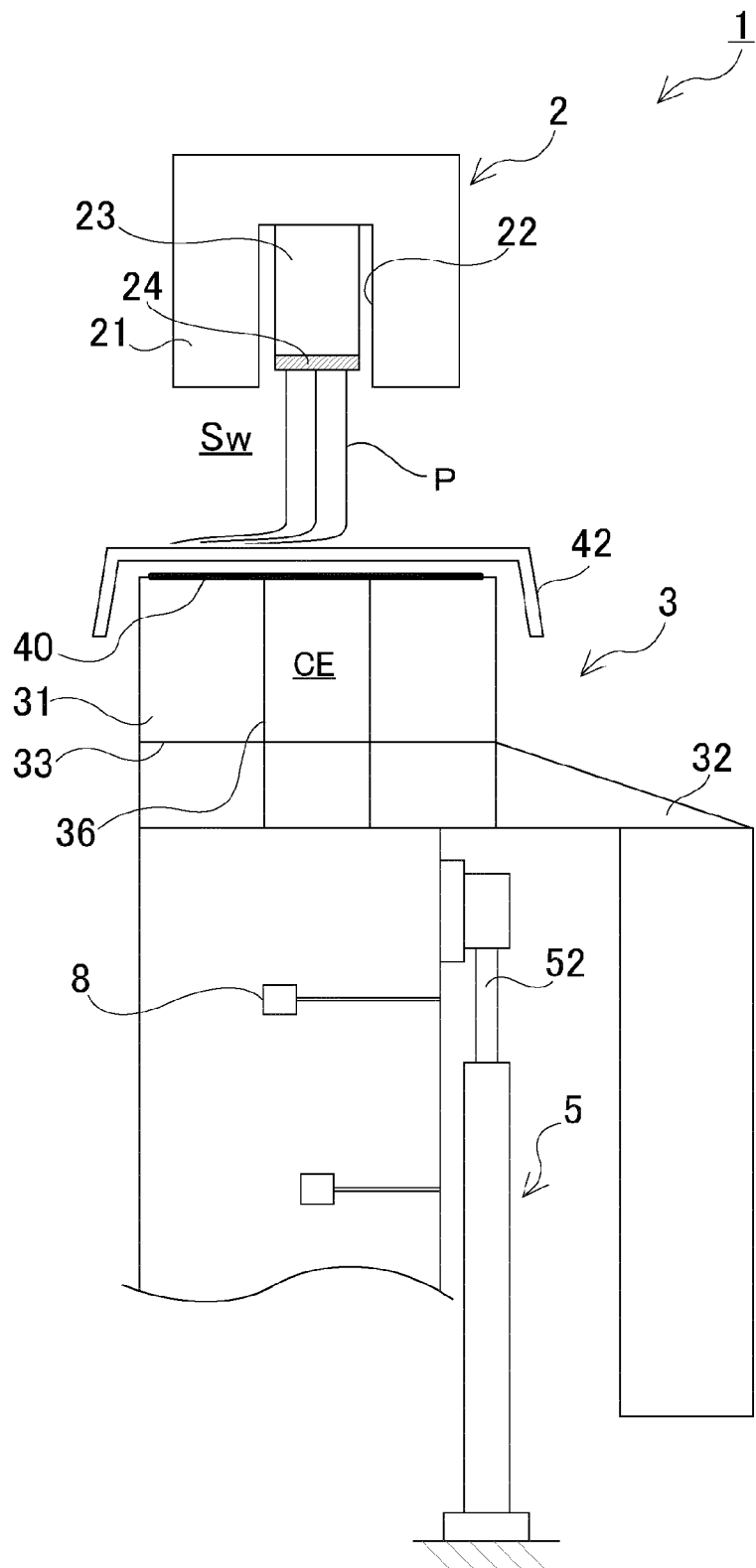


FIG. 18

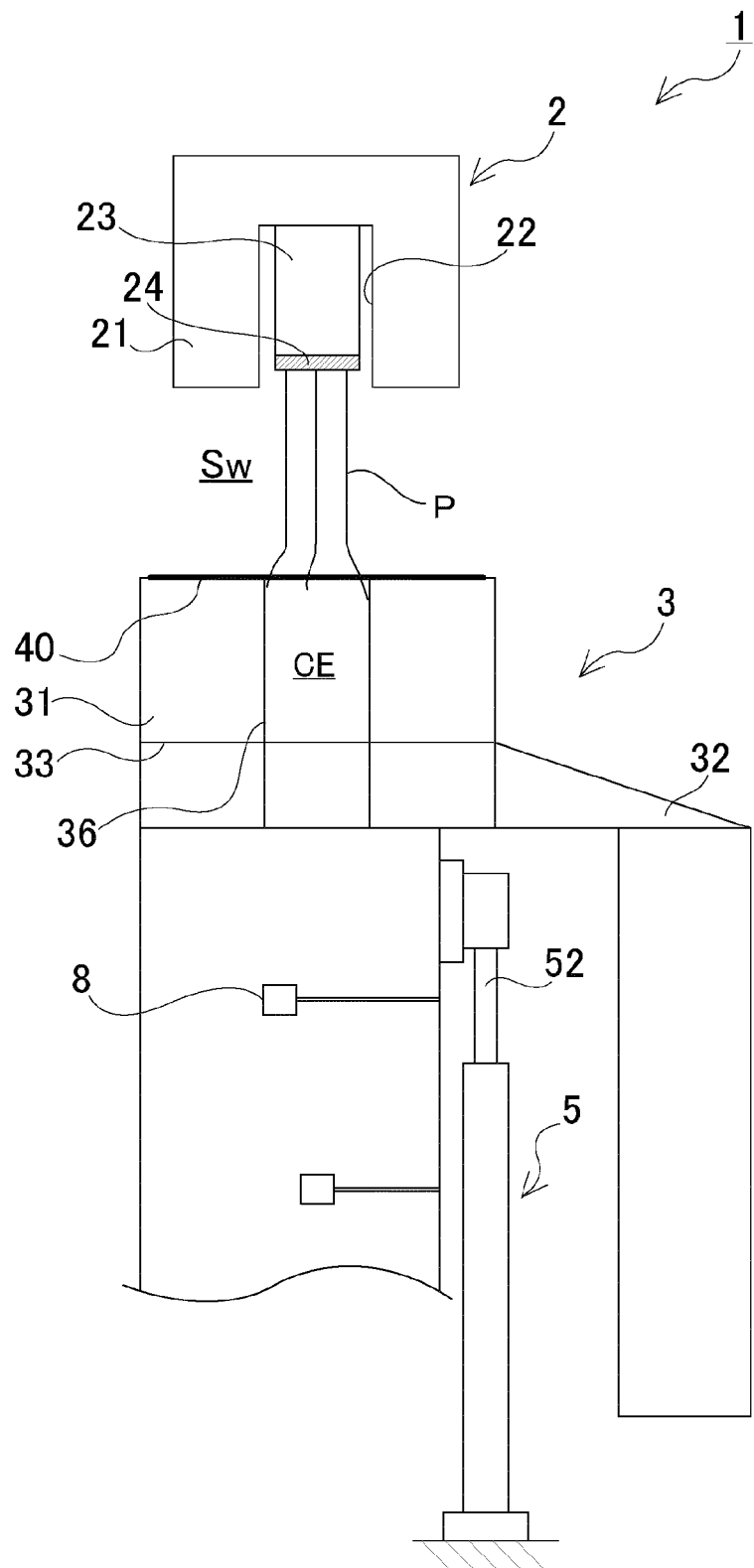


FIG. 19

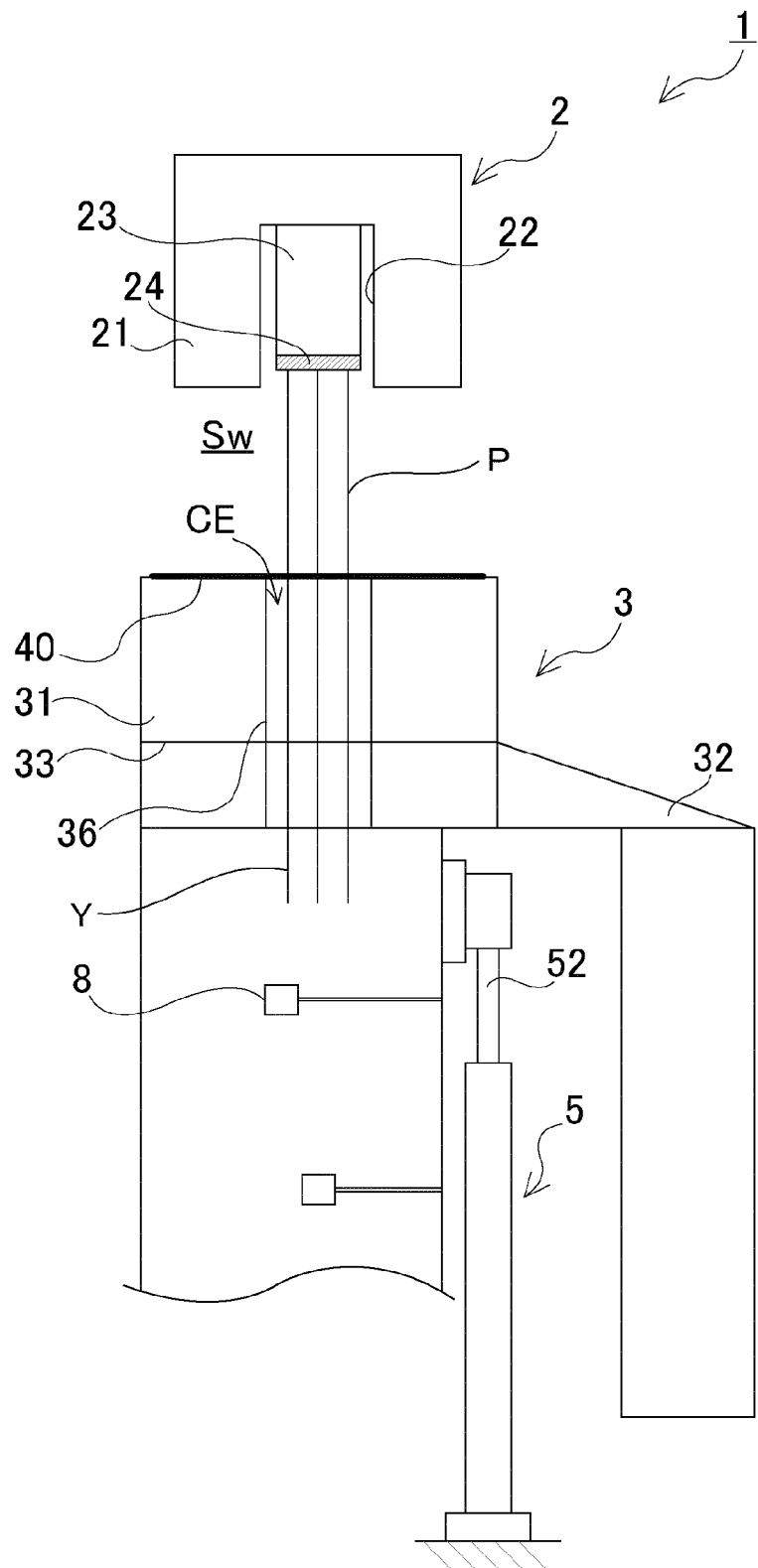


FIG. 20

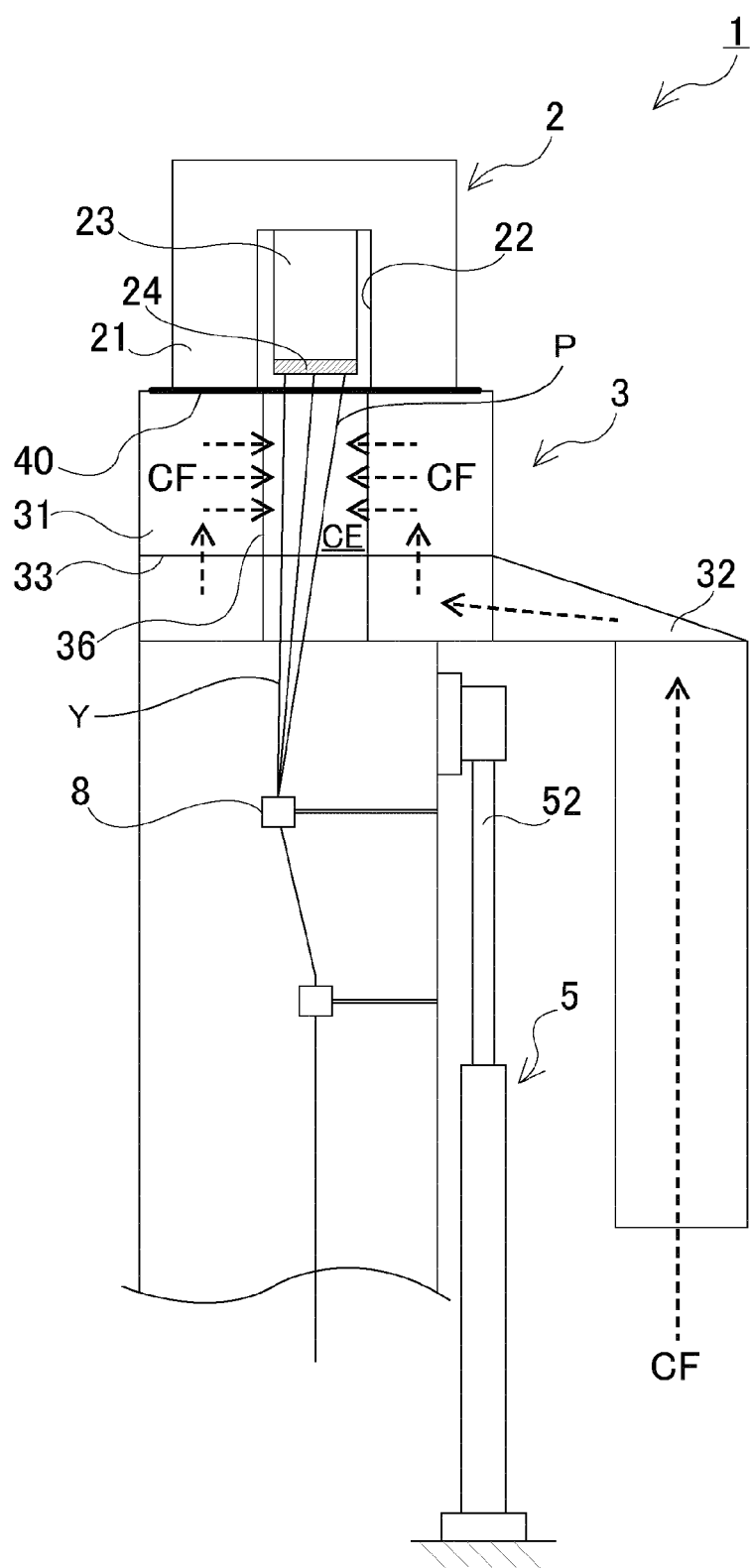


FIG. 21

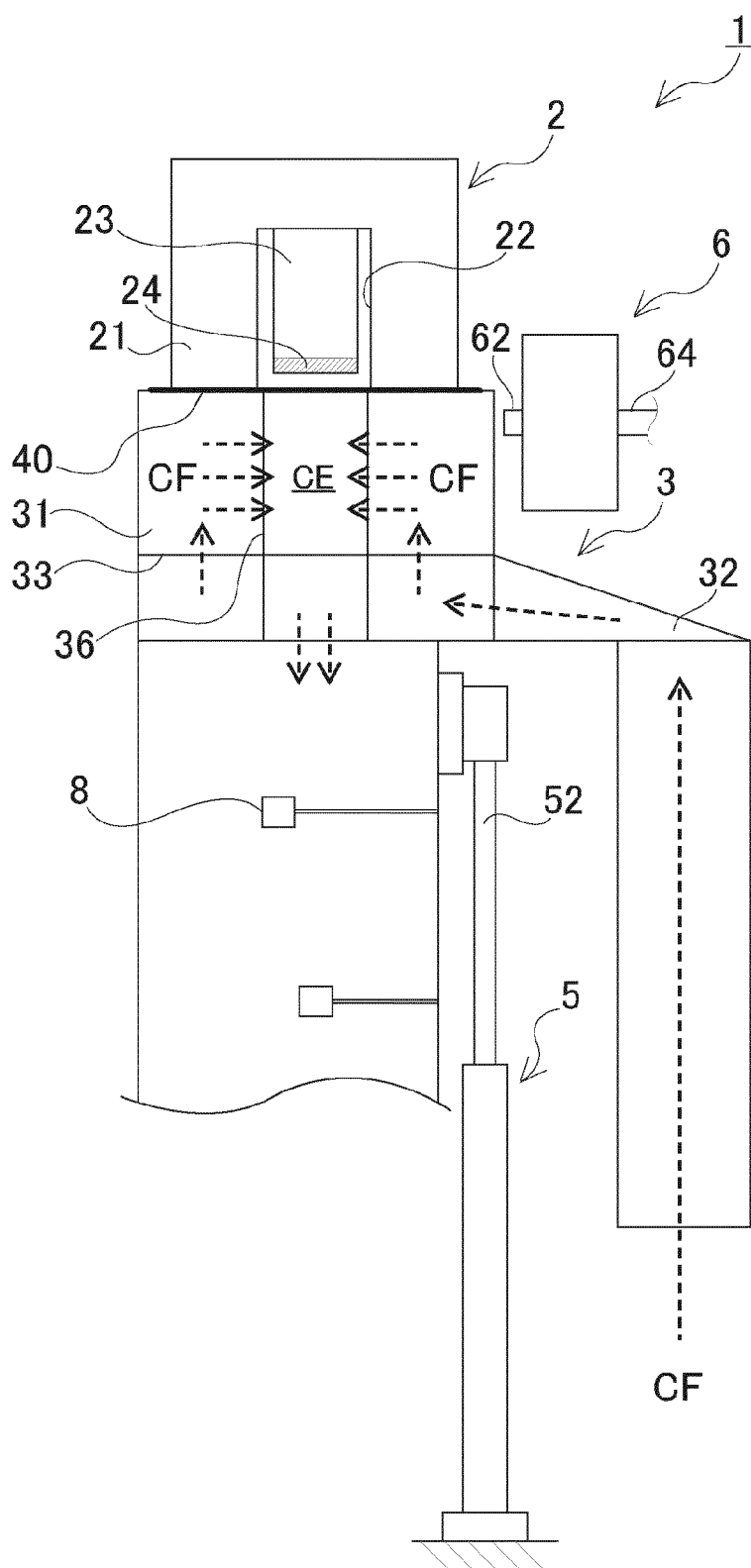


FIG. 22

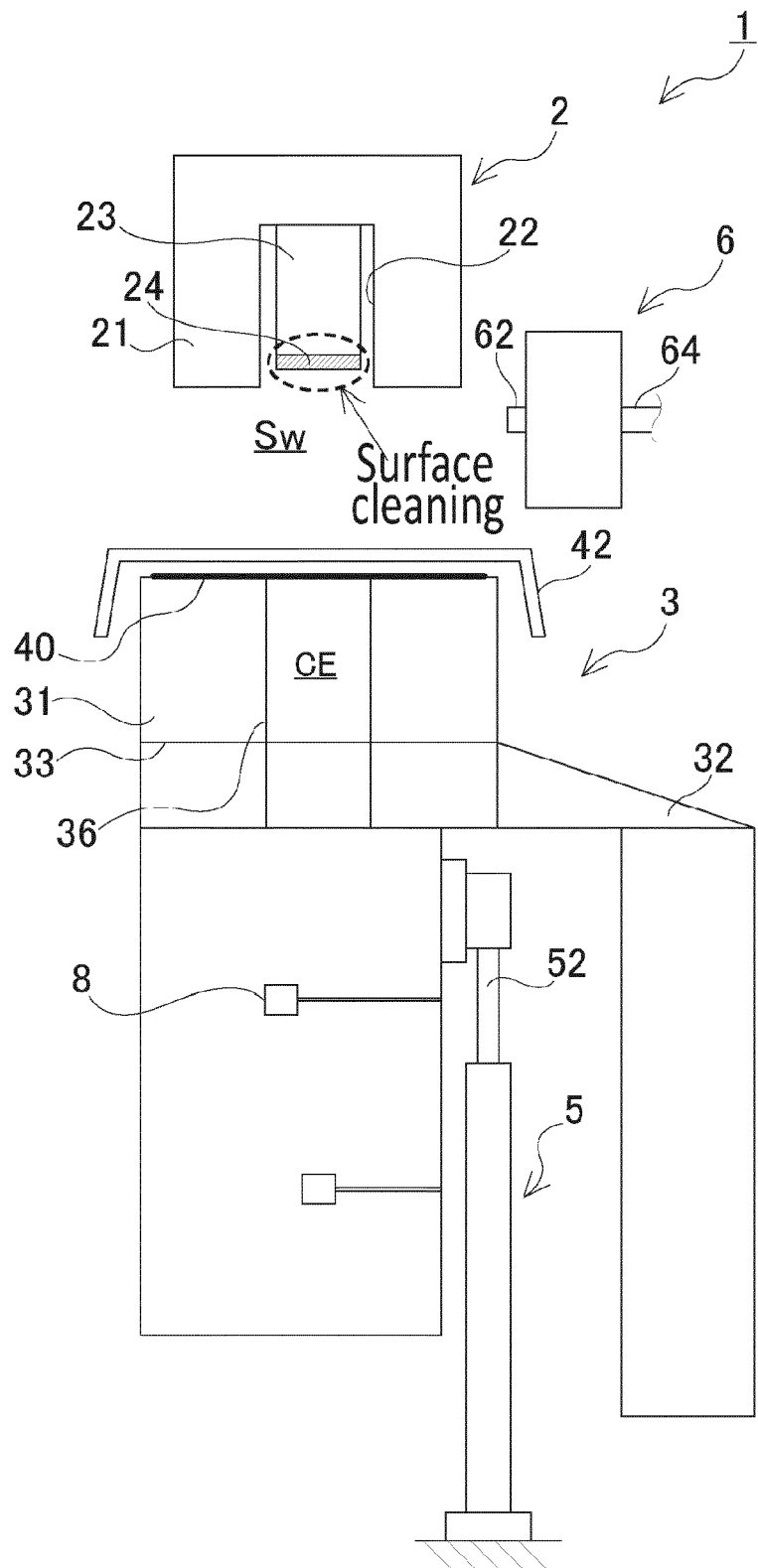


FIG. 23

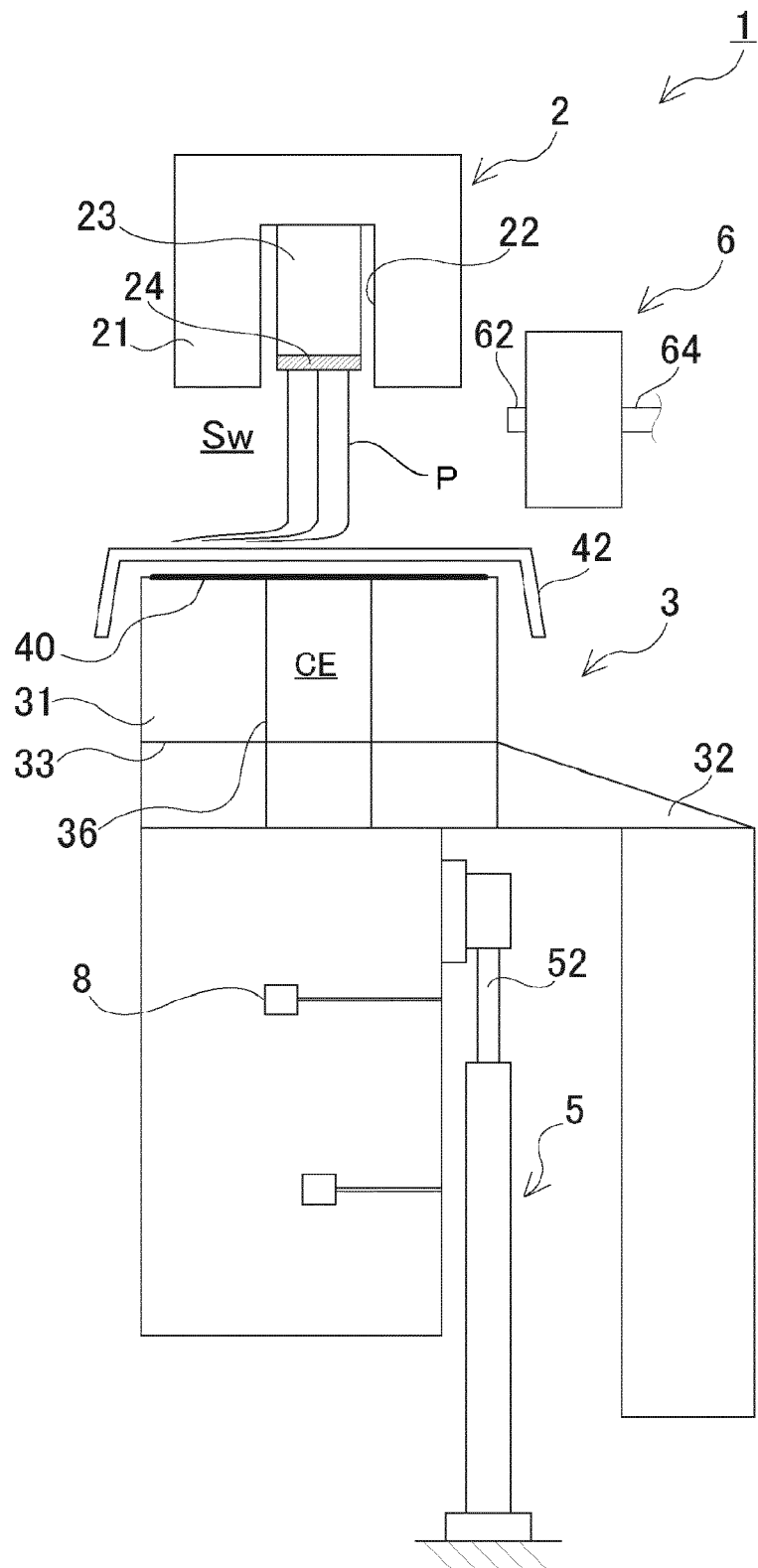


FIG. 24

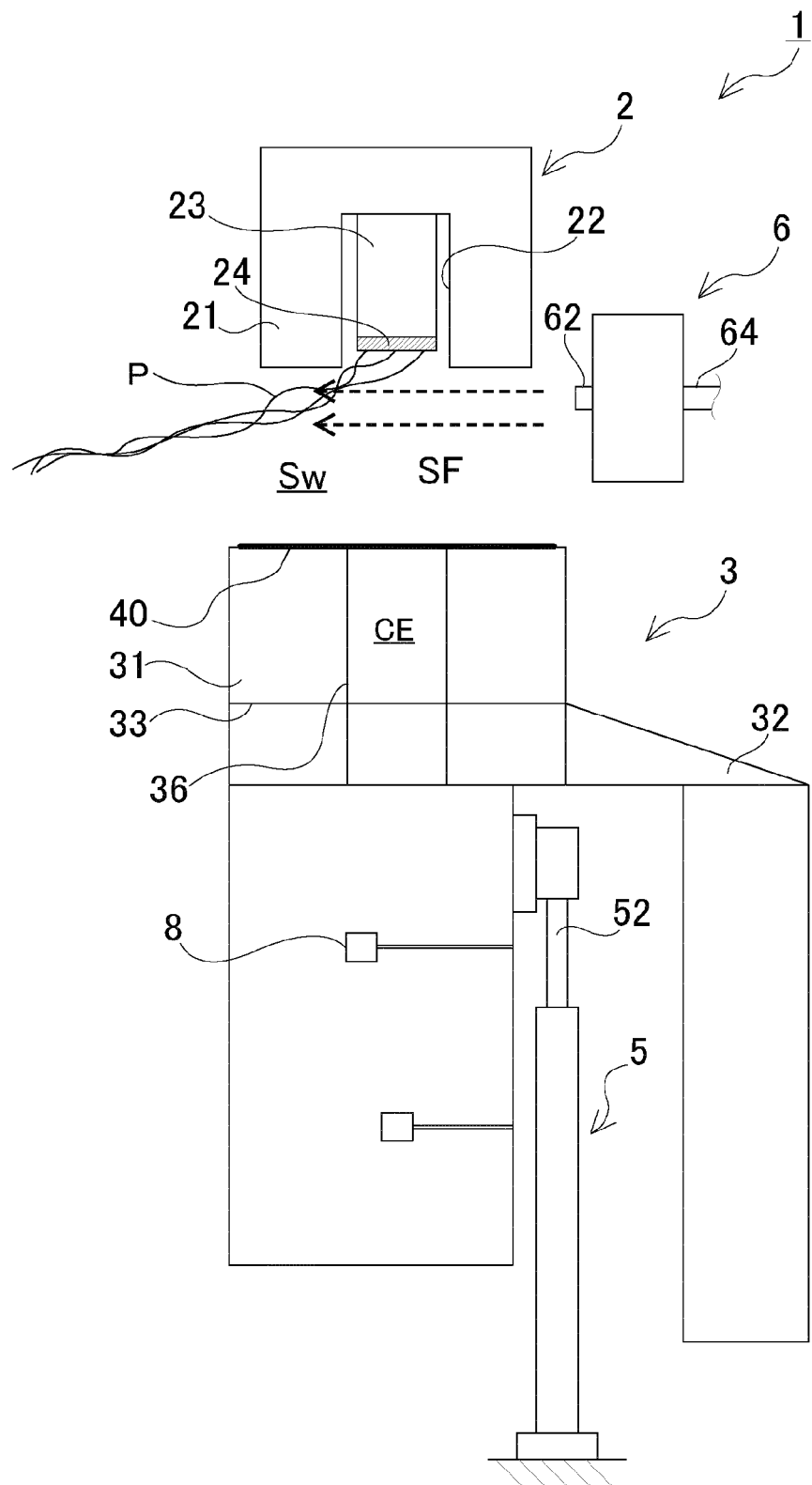


FIG. 25

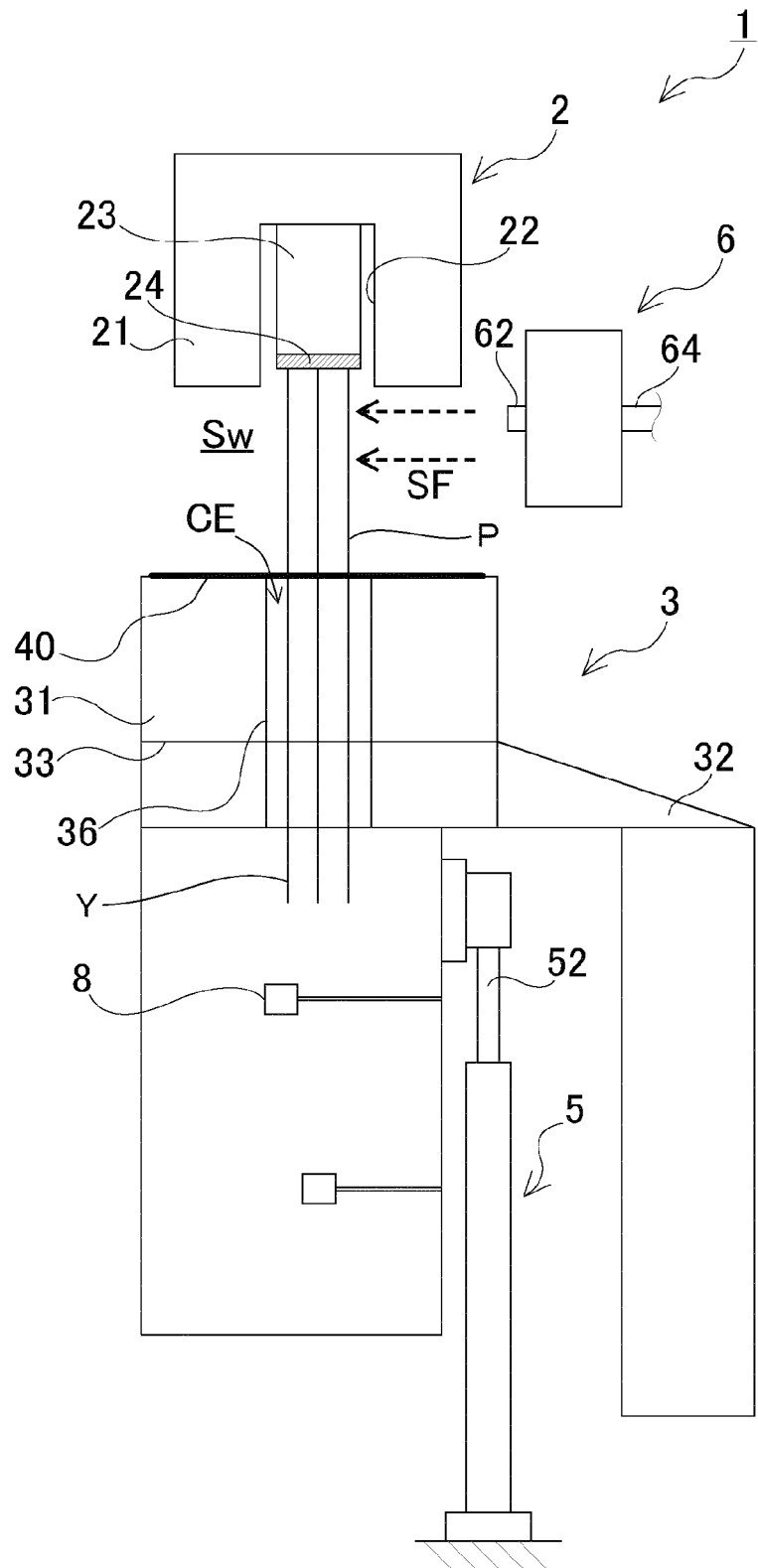


FIG. 26

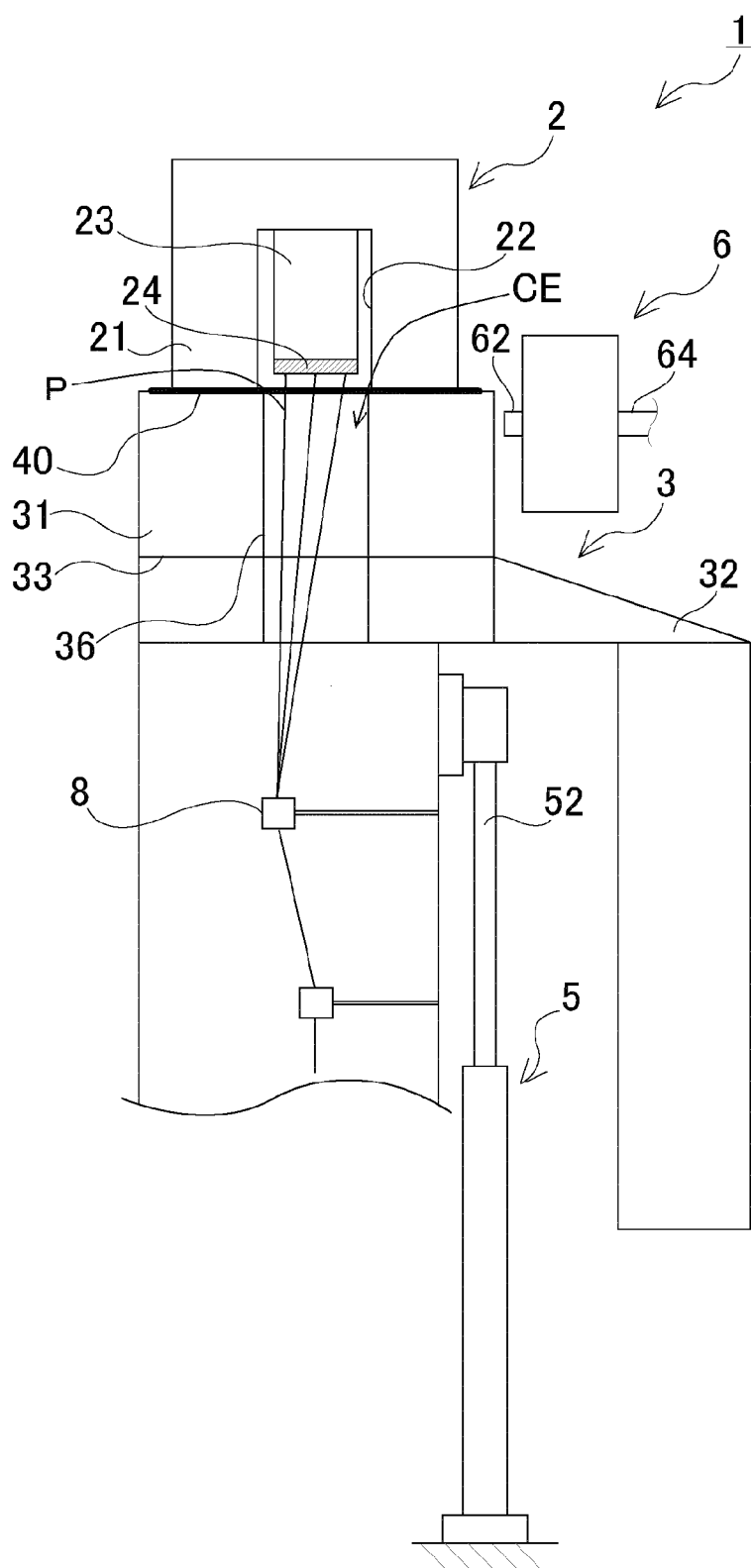


FIG. 27

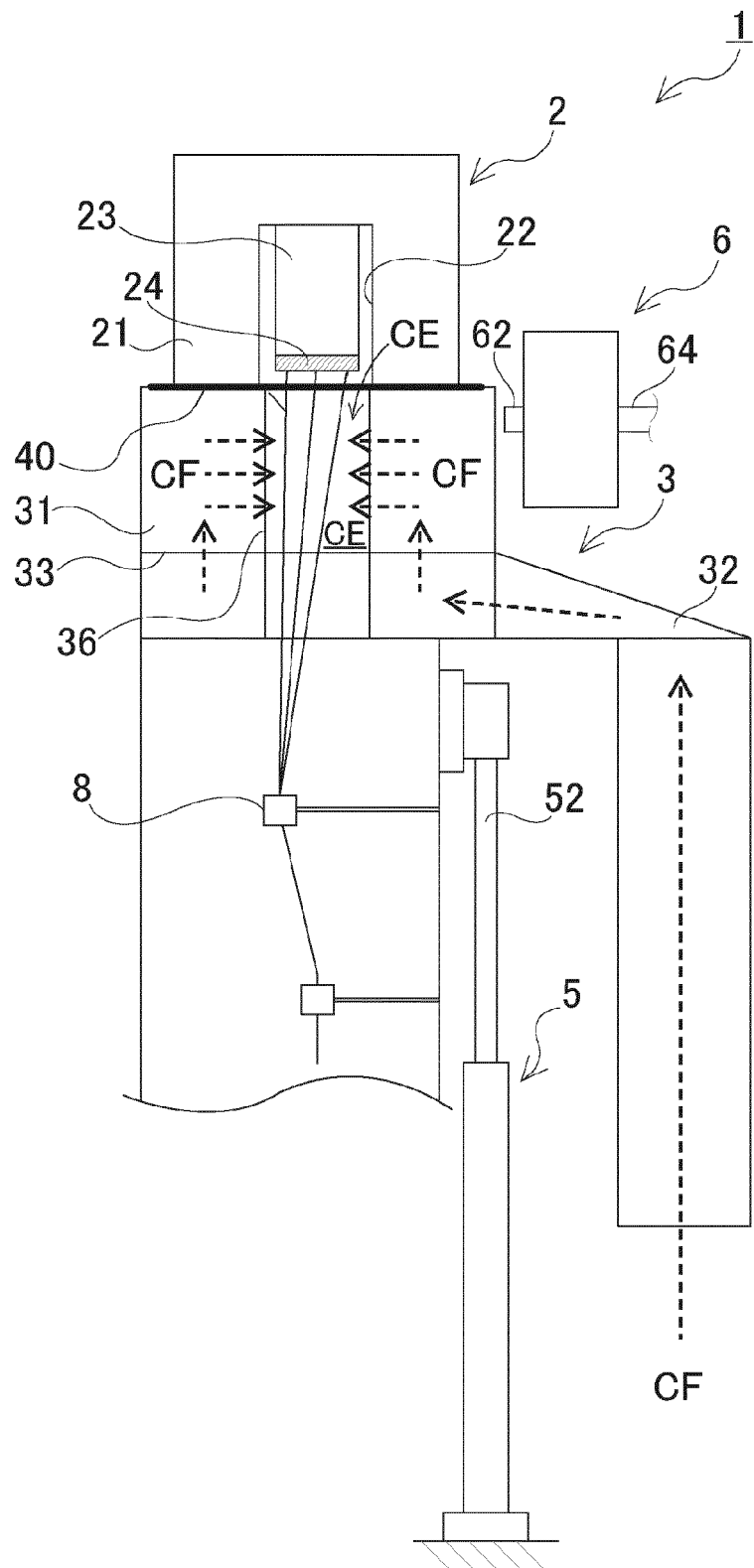


FIG. 28

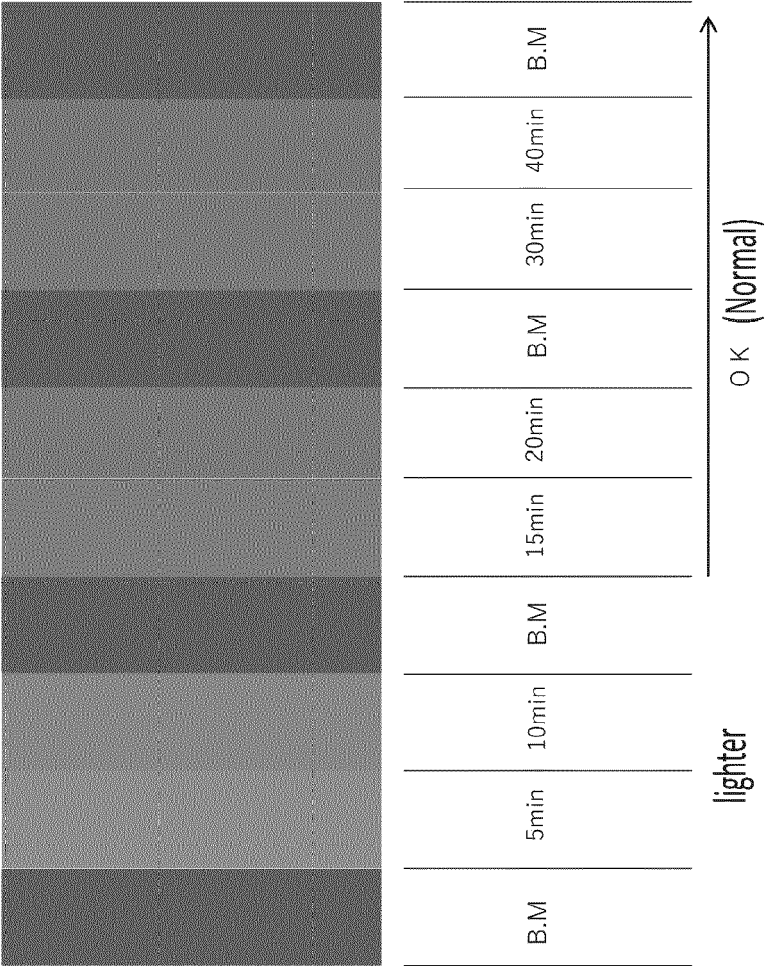


FIG. 29

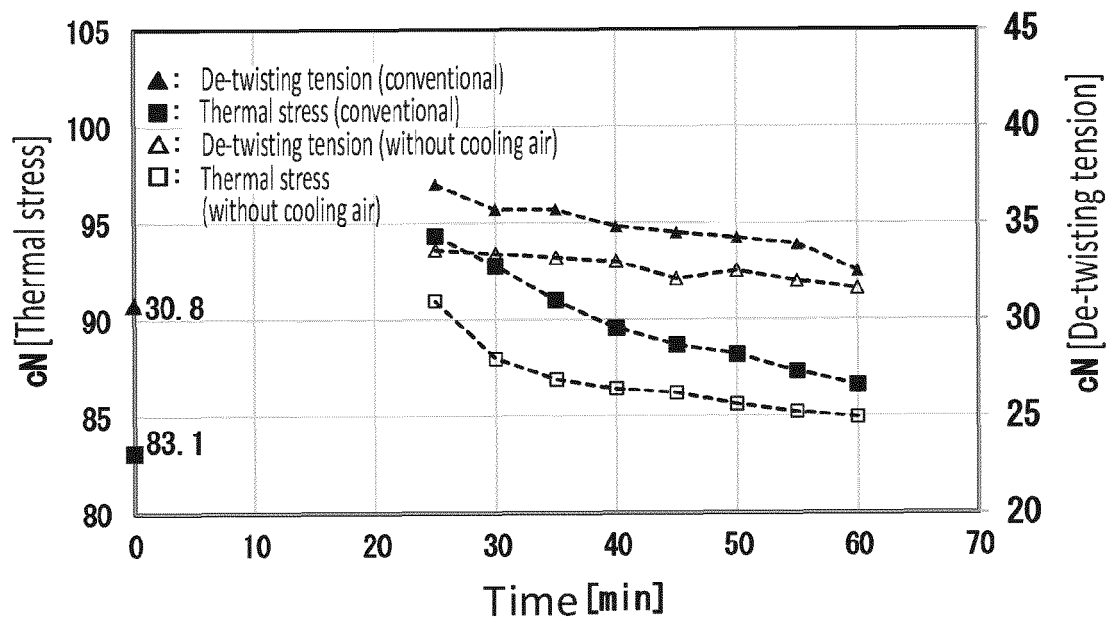
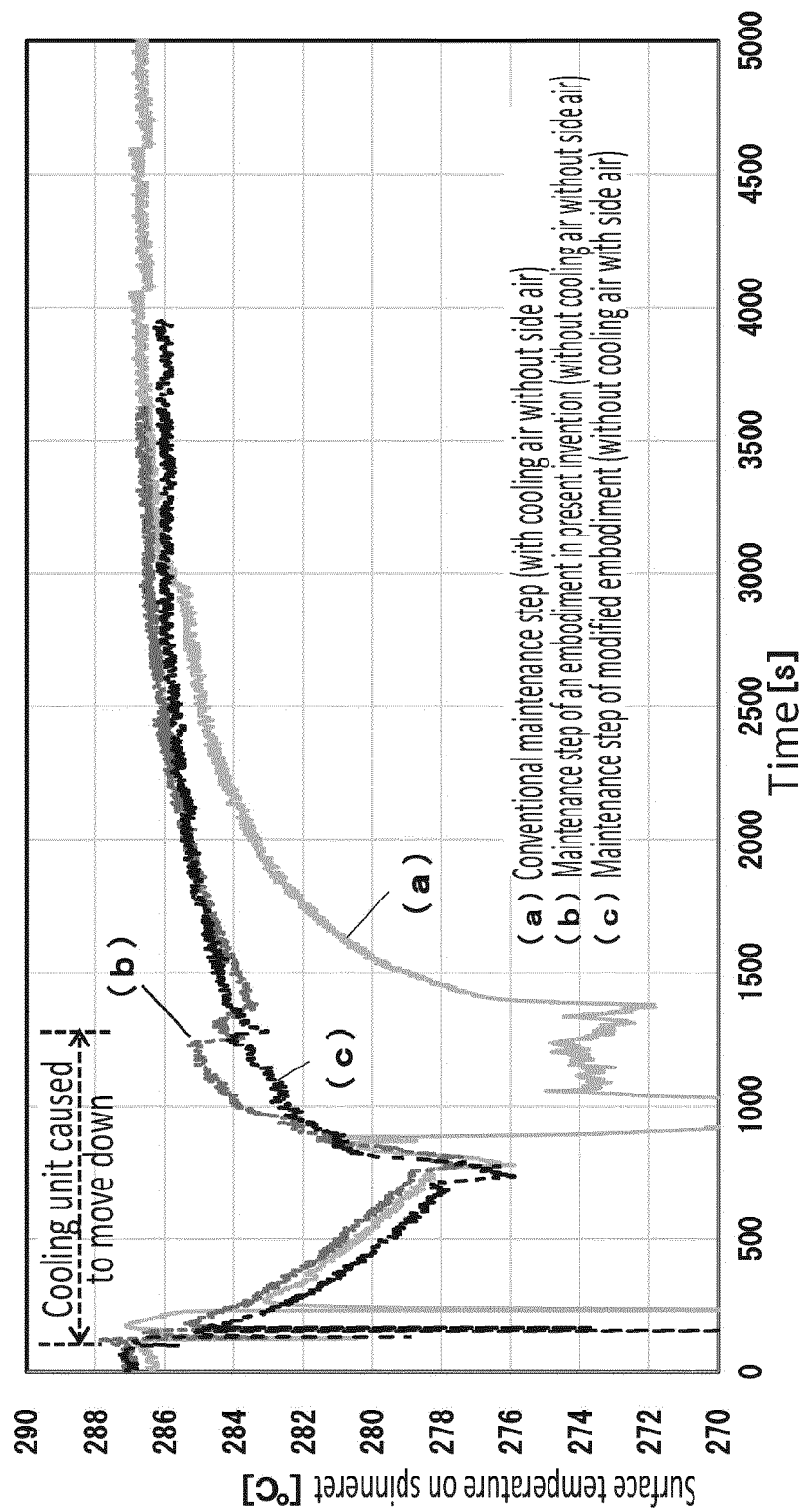


FIG. 30





EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2006 225792 A (TORAY INDUSTRIES) 31 August 2006 (2006-08-31)	1, 5	INV. D01D5/092
A	* figure 1 * * paragraphs [0028] - [0032] * -----	2-4, 6-8	D01D13/02
X	JP 2014 145132 A (TMT MACHINERY INC) 14 August 2014 (2014-08-14)	1, 5	ADD. D01D4/04
A	* figures 1, 3, 4 * * paragraphs [0021] - [0022], [0026] * -----	2-4, 6-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 July 2023	Examiner Verschuren, Jo
CATEGORY OF CITED DOCUMENTS			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 15 0248

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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17-07-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2006225792 A	31-08-2006	NONE	
JP 2014145132 A	14-08-2014	CN 103966679 A	06-08-2014
		DE 102014201298 A1	21-08-2014
		JP 2014145132 A	14-08-2014

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2014145132 A [0004]
- JP 2005042227 A [0004]