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

(11) **EP 2 843 093 A1**

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**04.03.2015 Bulletin 2015/10**

(51) Int Cl.:
***D04B 15/48*** *(2006.01)* ***D04B 15/56*** *(2006.01)*

(21) Application number: **14181601.7**

(22) Date of filing: **20.08.2014**

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

(30) Priority: **29.08.2013 JP 2013178438**

(71) Applicant: **SHIMA SEIKI MFG., LTD.**
**Wakayama 641-0003 (JP)**

(72) Inventors:
- **Ashibe, Shinsuke**
  **Wakayama, 641-0003 (JP)**
- **Waldmann, Martin**
  **01067 Dresden (DE)**
- **Trümper, Wolfgang**
  **01067 Dresden (DE)**
- **Cherif, Chokri**
  **01067 Dresden (DE)**

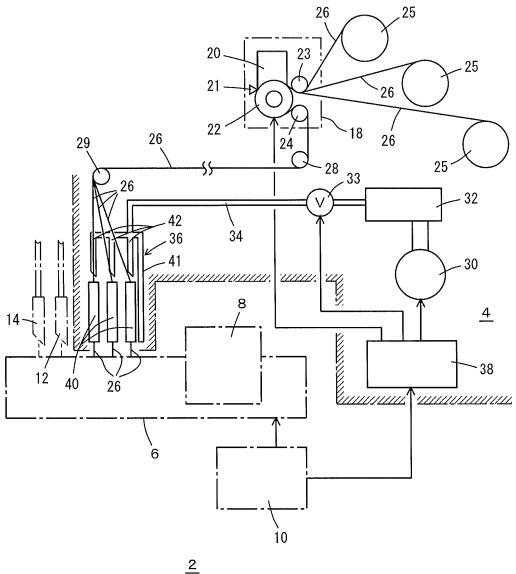
(74) Representative: **Carstens, Dirk Wilhelm**
**Wagner & Geyer**
**Gewürzmühlstraße 5**
**80538 München (DE)**

## (54) Warp yarn positive feeding device for knitting machine and knitting machine

(57) Configuration: A warp yarn positive feeding device (4) for a knitting machine (2) includes warp yarn pipes (40) through which warp yarns (26) pass and are fed to a trick gap of the knitting machine (2), driving rollers (22) that draw warp yarns (26) of a required length from warp yarn sources (25) and positively feeds the drawn warp yarns (26), and air pipes through which an air flow is blown into the warp yarn pipes (40) from an entrance side of the warp yarn pipes (40) so as to advance, within the warp yarn pipes (40), the warp yarns (26) to an exit side of the warp yarn pipes (40).

Effects: The warp yarns (26) of a required length are inserted into a knit structure.

F I G. 1




EP 2 843 093 A1

## Description

Technical Field

**[0001]** The present invention relates to a warp yarn positive feeding device for a knitting machine, and in particular to a device for feeding warp yarns of a required length in a knitted fabric, and to a knitting machine using this device.

Background Art

**[0002]** Patent Literatures 1 to 3 (JP2013-40411A, US2005/123715A, and WO97/21860) disclose knitting of a knitted fabric in which warp yarns are inserted into a knit structure. In such a knitted fabric, the warp yarns are fed from pipes to a trick gap of a knitting machine, and a binding yarn is knitted into the knit structure using needles of the knitting machine. Accordingly, the warp yarns are inserted into the knit structure. Furthermore, a weft yarn is inserted into the knit structure to form inlay stitches, tuck stitches, or the like, and thereby the knitted fabric is obtained that is made of, for example, the warp yarns, the weft yarn, and the binding yarn. When highly rigid yarns such as carbon fiber yarns, glass fiber yarns, or aramid yarns are used for the warp yarns and the weft yarn, a strong knitted fabric will be obtained. Furthermore, when a thermoplastic resin yarn is used for any one type of the warp yarn, the weft yarn, and the binding yarn, for example, the binding yarn, and the yarn is partially melted after knitting, the shape of the knitted fabric will be fixed.

**[0003]** Another conventional technique will be described. Patent Literature 4 (JP3603031B) discloses that a driving roller positively feeds a knitting yarn of a required length to a trick gap side from a yarn source. With this, a knitted fabric of a target size is knitted.

Citation List

Patent Literatures

**[0004]**

[Patent Literature 1] JP2013-40411A
[Patent Literature 2] US2005/123715A
[Patent Literature 3] WO97/21860
[Patent Literature 4] JP3603031B

Summary of the Invention

Technical Problem

**[0005]** The inventors are considering that a knitted fabric in which warp yarns are inserted into a knit structure is knitted into a flat and elongated shape and into a desired three-dimensional shape. Particularly, in order to knit a knitted fabric having a three-dimensional shape, it is preferable to perform flechage knitting, interlock knitting, or the like. In the flechage knitting (hereinafter, referred to simply as "flechage"), while a stitch, irrespective of whether or not it forms a next stitch, is retained on a needle, a yarn is fed to needles for forming next stitches and the next stitches are formed. Similarly, also in the interlock knitting, a yarn is fed only to some needles and the next stitches are formed. Assuming that a course direction (width direction) is a direction in which stitches are formed by a single movement of a carriage and a wale direction (height direction) is a direction that is orthogonal to the course direction, in the flechage or interlock knitting for example, the length in the wale direction, that is the height, of a knitted fabric varies according to the position, and a three-dimensional knitted fabric as well is knitted. Furthermore, the knitted fabric is pulled down by a take-down roller, but in the flechage or interlock knitting for example, it is difficult to apply an appropriate pull-down force to all the stitches.

**[0006]** The inventors experienced that, when a knitted fabric in which warp yarns are inserted into a knit structure was knitted by flechage, the warp yarns were not sufficiently inserted into the knit structure. This is because, in the flechage or interlock knitting for example, the pull-down force is often insufficient since the height of the knitted fabric is not uniform, and the pull-down force from the take-down roller is applied with difficulty to the warp yarns although it is applied to a binding yarn. If the warp yarns are not sufficiently inserted, the height of the knitted fabric will fall short in a corresponding part and thus the knitted fabric will not have a desired shape.

**[0007]** The present invention is to solve the problem that desired amounts of warp yarns cannot be inserted because the number of courses differs within a knitted fabric and the knitted fabric cannot appropriately be pulled down by a take-down roller.

**[0008]** It is an object of the present invention to provide a warp yarn positive feeding device for a knitting machine in which warp yarns of a required length are inserted into a knit structure.

Means for Solving Problem

**[0009]** The present invention is directed to a warp yarn positive feeding device for a knitting machine including a plurality of warp yarn pipes through which warp yarns pass and are fed to a trick gap of the knitting machine, characterized in that the warp yarn positive feeding device further includes: a powered roller mechanism that includes a plurality of driving rollers for drawing warp yarns from a plurality of warp yarn sources and positively feeding the drawn warp yarns, each driving roller drawing at least one warp yarn by a required length; and an air injection mechanism for feeding, by blowing an air flow into the warp yarn pipes, the warp yarns drawn by the powered roller mechanism to the trick gap of the knitting machine.

**[0010]** In the present invention, warp yarns are inserted

into a knit structure by a combination of the driving roller drawing the warp yarns of a required length from the yarn sources and positively feeding the drawn warp yarns, and blowing of an air flow into the warp yarn pipes so that the warp yarns advances to the exit side of the warp yarn pipes. According to the experiences of the inventors, the warp yarns of a required length are inserted not by using either of the features of the combination but both of the features. The driving rollers draws warp yarns from the yarn sources, and feeds the warp yarns of a required length into the warp yarn pipes. Then, by blowing of an air flow into the warp yarn pipes, the warp yarns advance, within the pipes, to the exit side of the pipes and are inserted into the knit structure. Note that, when the present invention is combined with the invention of Patent Literature 4 and the driving rollers draw binding yarns of a required length, or binding yarns and weft yarns that have required lengths, and positively feed them, a knitted fabric having a desired size is knitted with accuracy.

**[0011]** According to the present invention, knitted fabrics having various shapes are knitted by flechage or interlock knitting for example, and a knitted fabric having a desired size is knitted even when flechage or interlock knitting for example is performed. Hereinafter, three-dimensional knitting by flechage or interlock knitting for example is referred to as three-dimensional knitting. Furthermore, although it is also possible to knit a knitted fabric without using a take-down roller, the knitting machine may include the take-down roller. It is possible, without positive feeding of warp yarns and blowing of an air flow, to knit a section of a knitted fabric on which knitting other than the three-dimensional knitting is performed into a substantially desired shape, and thus positive feeding of warp yarns by the driving rollers and blowing of an air flow may be omitted in that section. However, in order to knit a knitted fabric with a desired shape, it is preferable to perform positive feeding of warp yarns by the driving rollers and blowing of an air flow on the section on which knitting other than the three-dimensional knitting is performed. Furthermore, when an air flow from air pipes is used, the warp yarns easily pass through the warp yarn pipes and are set therein. Note that, if the warp yarn pipes are movable to the right and left directions, the warp yarn pipes will serve also as carriers for carrying a weft yarn or the like that is inserted to form inlay or tuck stitches, and there is no need to provide pipes dedicated for warp yarn. Since the plurality of driving rollers are controlled independently, a required amount of warp yarns is inserted at required positions of the knitted fabric.

**[0012]** It is preferable that a controller be further provided that controls the powered roller mechanism such that the driving rollers feed the warp yarns of a required length according to knitting. When, for example, the knitting machine performs flechage knitting, interlock knitting, or the like, the controller feeds warp yarns of a required length. Feeding of warp yarns is preferably performed for every course or every two courses in the flechage knitting, the interlock knitting, or the like. A required length of the warp yarns is determined based on, for example, knitting data. Furthermore, at that time, an air flow is blown into the warp yarn pipes from the air pipes. With this, the warp yarns of a required length are inserted into a region in which new stitches are to be formed and the air flow advances the warp yarns within the warp yarn pipes. Note that in a region in which stitches are not to be formed, the required length of the warp yarns is, for example, 0 (zero), whereas in a region in which stitches are to be formed, the required length of the warp yarns is equal to, for example, the size of one stitch in the height direction. Note here that when a knit stitch, a miss stitch, and a knit stitch are knitted in the stated order, two sides of the miss stitch are the knit stitches and the location of the miss stitch is included in the region in which stitches are to be formed, and the warp yarns are also fed to the location of the miss stitch. Data for controlling the driving rollers and data indicating whether or not it is necessary to blow air is obtained by, for example, analyzing the knitting data of the knitted fabric, but the data may be set manually.

**[0013]** It is preferable that the air injection mechanism include a plurality of air pipes through which air is injected into the warp yarn pipes; and each driving roller be configured to feed a plurality of warp yarns such that the fed warp yarns are inserted into the respective warp yarn pipes. It is also possible that each driving roller feeds one warp yarn, but since a plurality of warp yarns are used, use of the same number of the driving rollers as that of the warp yarns may require a larger space for the powered roller mechanism. Therefore, when one driving roller feeds a plurality of warp yarns that are, for example, adjacent to each other, that is, e.g., two to five warp yarns to a plurality of warp yarn pipes that are, for example, adjacent to each other, the number of the powered roller mechanism is reduced.

**[0014]** It is preferable that the air injection mechanism further include an air pipe for weft yarn through which air is blown into the trick gap from above so as to press a weft yarn when the weft yarn is inserted in a course direction. With this, the weft yarn (inlay yarn or the like of the embodiment) is prevented from floating up from the trick gap.

**[0015]** It is preferable that the plurality of warp yarn pipes and the plurality of air pipes be provided, and a tube be further provided through which an air flow is fed to the plurality of air pipes, for example, five to fifty air pipes at the same time. With this, the numbers of the tube and of the valve are reduced.

**[0016]** According to the experiences of the inventors, when the warp yarns are fed to the trick gap from the warp yarn pipes, the warp yarns are inserted into the trick gap more efficiently by blowing an air flow in a pulsed manner, that is, intermittently and repeatedly than by continuously blowing air with a constant amount of flow volume. Furthermore, it is also possible to continuously blow an air flow from the air pipes to the warp yarn pipes on a steady basis, but an air flow may be stopped when the

warp yarns are not fed and a knit structure is not knitted. Note that, by increasing an air flow at a position at which warp yarns are fed and decreasing the air flow at a position at which warp yarns are not fed, the warp yarns are caused to stand upright from the back of the trick gap so as not to interfere with the needles of the needle beds. Here, when air is supplied in a pulsed manner, the average flow is increased at a position at which warp yarns are fed, and the average flow is decreased at a position at which warp yarns are not fed.

**[0017]** It is preferable that the powered roller mechanism be controlled such that, when the knitting machine knits a three-dimensional knitted fabric, warp yarns of a required length are positively fed to the trick gap. Since warp yarns of a required length are reliably fed when a three-dimensional knitted fabric is knitted, a three-dimensional knitted fabric having a desired shape is knitted.

**[0018]** Furthermore, the present invention is directed to a knitting machine including the above-described warp yarn positive feeding device. The knitting machine includes needle beds, and a carriage that moves on the needle beds and operates needles, or linear motors for the respective needles, in which a binding yarn is fed from a carrier, and when a weft yarn is inserted, the weft yarn is fed from a carrier for weft yarn. Furthermore, the knitting machine may be a flat knitting machine or a circular knitting machine. This knitting machine may not necessarily include a take-down roller, and a knitted fabric in which warp yarns are inserted is knitted in a desired shape.

Brief Description of the Drawings

**[0019]**

FIG. 1 is a block diagram illustrating a warp yarn positive feeding device and a flat knitting machine, according to an embodiment.
FIG. 2 is a front view illustrating main parts of yarn feeding pipes of the embodiment.
FIG. 3 is a flowchart illustrating a warp yarn feeding algorithm of the embodiment.
FIG. 4 is a diagram illustrating a timing at which warp yarns are positively fed of the embodiment, in which, specifically,

1) indicates hardware such as a positive feeding device;
2) indicates an operation of a yarn feeding roller; and
3) indicates blowing of air.

FIG. 5 is a perspective view illustrating a multi-layer knitted fabric knitted according to the embodiment.
FIG. 6 is a diagram illustrating a structure of the knitted fabric of FIG. 5.
FIG. 7 is a diagram illustrating a structure of a knitted fabric according to a modification.

Description of Embodiment

**[0020]** The following will describe a preferred embodiment for carrying out the present invention.

Embodiment

**[0021]** FIGS. 1 to 7 show a warp yarn positive feeding device 4 (hereinafter, referred to as "feeding device 4") according to the embodiment, and a flat knitting machine 2 that includes the warp yarn positive feeding device 4, in which the flat knitting machine 2 may be a circular knitting machine instead of the flat knitting machine. The flat knitting machine 2 includes a pair of, for example, front and rear needle beds 6, and a carriage 8, which reciprocates on the needle beds 6 and operates needles of the needle beds 6 so that a knit structure of a knitted fabric is knitted. The reference numeral 10 denotes a controller of the flat knitting machine 2, and the controller controls the carriage 8 or the like based on knitting data on the knitted fabric. The reference numerals 12 and 14 denote carriers, specifically, the reference numeral 12 denotes a carrier for carrying a binding yarn (knitting yarn) that forms a knit structure of the knitted fabric, and the reference numeral 14 denotes a carrier for carrying a weft yarn that is inserted into the knitted fabric to form inlay stitches or tuck stitches. The carriers 12 and 14 are taken by the carriage 8 or run in synchronization with the carriage 8, and a binding yarn or a weft yarn is fed from a yarn source (not shown) so as to pass through the corresponding pipe of the carrier 12 or 14 and reach a trick gap between the needle beds 6. Note that, when a single needle bed 6 is used, a region at the tip of the needle bed in which needles advance and retreat to form stitches serves as the trick gap.

**[0022]** A powered roller mechanism 18 includes driving rollers 22, which are rotated by a motor 20 such as a stepping motor or a servomotor, and an encoder 21, which monitors the rotating speed of the driving rollers 22 or the motor 20. The powered roller mechanism 18 further includes driven rollers 23 and 24 on which warp yarns 26 are put so as to be transferred to the driving rollers 22. Warp yarns 26 from, for example, three yarn sources 25 (cone, bobbin, and the like) are wound and put on the same driving roller 22, drawn by a required length, and fed into warp yarn pipes of a pipe assembly 36 via rollers 28 and 29, and the like. Since the powered roller mechanism 18 includes the plurality of driving rollers 22 and controls them independently, the warp yarns of a required length are drawn from the yarn sources 25 for each knitting position. The reference numeral 30 denotes a compressor, and the compressor generates compressed air, accumulates the compressed air in a tank 32, and supplies the compressed air into a tube 34 via a valve 33 and into air pipes 41 and 42 of the pipe assembly 36. Among these components, the air pipe 41 is an air pipe for weft yarn, and the air pipes 42 are air pipes for warp yarn. Note that the warp yarn 26 may be sand-

wiched between the driving roller 22 and the driven rollers, and the driving roller 22 needs only to be rotated by a target angle of rotation while preventing the warp yarn 26 from slipping with respect to the driving roller 22.

**[0023]** FIG. 2 shows the pipe assembly 36 in which typically ten to one hundred of warp yarn pipes 40, specifically, e.g., twenty-one warp yarn pipes 40 are mounted on a base 44. The same number of air pipes 42 for warp yarn as that of the warp yarn pipes are mounted on a base 45, and a compressed air flow is blown into the warp yarn pipes 40 from slightly above the top ends of the warp yarn pipes 40 to advance the warp yarns 26 within the pipes 40. Compressed air is blown into the trick gap through the air pipe 41 for weft yarn in order to press a weft yarn (not shown), preventing the weft yarn from floating up. Compressed air is supplied to each pipe assembly 36 through the tube 34, and blowing of the compressed air is turned on/off for each pipe assembly 36. Furthermore, three warp yarns 26 are drawn by one driving roller 22, and are respectively fed into three warp yarn pipes 40. Therefore, it is preferable that a pattern of the knitted fabric vary by three warp yarns as a unit. Note that the tank 32 and the air pipe 41 for weft yarn may be omitted. Furthermore, the pipe assembly 36 includes the arrangement of the plurality of warp yarn pipes 40 and the air pipes 41, 42, and has any structure. One or more pipe assemblies 36 are arranged along the needle beds 6.

**[0024]** Returning to FIG. 1, the controller 38 of the feeding device 4 controls the motor 20, the compressor 30, and the valve 33. The controller 38 receives, from the controller 10 of the flat knitting machine, data indicating which warp yarns are to be inserted in the next course (the next stroke of the carriage 8), and performs control such that the driving rollers draw the warp yarns to be inserted by a required length, and air is blown into a pipe assembly 36 in which the warp yarns to be inserted are placed. This data may be one that clearly indicates warp yarns that are to be inserted, or one that indicates needles for forming stitches. In the case where the data indicates needles for forming stitches, the controller 38 determines the required warp yarns based on the needles. In a section of the knitted fabric that is other than ends thereof, the required length of the warp yarns is defined as being equal to the height of one stitch, and in sections of the knitted fabric at which knitting starts and ends, the required length of the warp yarns may vary from the height of one stitch. The required length of the warp yarns is designated by knitting data of the knitted fabric, and the controller 10 sends a required length of the warp yarn to the controller 38 by an appropriate method. Note that the controller 38 may be omitted, and the controller 10 of the flat knitting machine, instead of the controller 38, may also control the motor 20, the compressor 30, and the valve 33. According to the length of the knitted fabric in the height direction, the length of the knitting yarn that is to be drawn is controlled for each driving roller 22 as a unit. Note that, when each driving roller 22 is configured to draw one warp yarn, the length of each warp yarn that is to be inserted into the knitted fabric varies. Furthermore, a timing at which warp yarns are fed may be a timing of every course, every two courses, or the like of the knit structure into which the warp yarns are inserted.

**[0025]** FIGS. 3 and 4 show the algorithm in which the warp yarns 26 are fed. In step 1, a required length of the warp yarns 26 in the next course is obtained, and when the carriage 8 approached the warp yarn pipes 40 (Step 2), feeding of the warp yarns 26 and blowing of air (Steps 3 and 4) are performed. It is preferable that feeding of the warp yarns 26 by the driving roller 22 be performed at the same time as formation of stiches at two sides of the warp yarns 26 but, since three warp yarns 26 are fed together, feeding of the warp yarns 26 is performed before formation of stitches around the warp yarns 26 is completed. Also, it is preferable that blowing of air be performed at the same time as formation of stitches at two sides of the warp yarns 26 but since, blowing of air is turned on/off for each pipe assembly 36 as a unit, air is being blown for a time period that is longer than the period required for forming stitches at two sides of the warp yarns 26. The warp yarns 26 are reliably fed to the trick gap with a reduced amount of air when blowing of air is turned on/off in a pulsed manner as shown in the lower right of FIG. 4 than when a constant amount of air is blown. Furthermore, when the carriage has passed by, blowing of air is stopped or weakened (Steps 5 and 6).

**[0026]** FIG. 5 shows the example of the knitted fabric and FIG. 6 shows the main part of this knitted fabric 60. The reference numerals 62 denote normal sections in which normal knitting instead of flechage is performed, and the reference numerals 64 are flechage sections 64 in which flechage is performed. Lines 65 do not indicate borders and the like but the same position on the knitted fabric 60, and lines 66 similarly indicate the same position. For example, between the lines 65, stitches are retained on needles and knitting is not performed. Then, assuming that knitting is performed upward from the lower part of FIG. 6, knitting is stopped when having passed by the lower line, and knitting starts again when having passed by the upper line. Upward projections shown in FIG. 5 are knitted by flechage.

**[0027]** The structure of the knitted fabric 60, with respect to a region 67, is shown in the lower part of FIG. 6. In addition to the warp yarns 26, the weft yarns 68 are fed from the carrier 14 and inserted into the knitted fabric 60 to form inlay stitches or tuck stitches. Then, a knit structure is knitted using a binding yarn (not shown), in which the warp yarns 26 and the weft yarns 68 are fixed to the knitted fabric 60 due to, for example, a frictional force between the warp yarns 26 and the weft yarns 68, and the binding yarn. Note that it is also possible that the weft yarns 68 are not inserted. Furthermore, in the sections located above and below the lines 65, the warp yarns 26 are continuous, and in the section indicted by dashed lines, the warp yarns 26 do not actually exist. It is clear that the three warp yarns on the left of FIG. 6 are

longer than the three warp yarns on the right, according to the knitting height.

**[0028]** FIG. 7 shows a knitted fabric 70 in which weft yarns 72 are arranged also in the height direction by stopping the carrier 14 for weft yarn. In this example, the carrier 14 for weft yarn has the same pipe as the warp yarn pipe 40, and an air pipe through which compressed air is blown so as to feed the weft yarns 72 in the height direction, and the weft yarn is fed by a required length from a powered roller mechanism for the weft yarns 72. In this case, the knitting width in the course direction varies depending on the position in the height direction. Furthermore, the carrier 14 for weft yarn serves also as a carrier for feeding warp yarns when the carrier 14 is fixed.

**[0029]** In the embodiment, since the warp yarns 26 of a required length are reliably inserted into the knitted fabric at knitting positions of the knitted fabric, a knitted fabric having an exact size in the height direction is knitted. Furthermore, a knitted fabric having a desired shape such as three-dimensional shape is knitted by flechage. Also, by selecting materials for the warp yarn, the weft yarn, and the binding yarn, a knitted fabric is obtained that has a desired strength, heat resistance property, degree of elasticity, and the like. The knitted fabric may be a multi-layer knitted fabric knitted with weft yarns and warp yarns, a three-dimensional knitted fabric, or a flat knitted fabric having a single layer. A three-dimensional knitted fabric is knitted not only by flechage but also interlock knitting, and in the case of interlock knitting, similarly to the case of flechage, a three-dimensional knitted fabric is knitted while weft yarns and warp yarns are inserted.

List of Reference Numerals

**[0030]**

| | |
|---|---|
| 2 | Flat knitting machine |
| 4 | Warp yarn positive feeding device |
| 6 | Needle bed |
| 8 | Carriage |
| 10 | Controller |
| 12, 14 | Carrier |
| 18 | Powered roller mechanism |
| 20 | Motor |
| 21 | Encoder |
| 22 | Driving roller |
| 23, 24 | Driven roller |
| 25 | Yarn source |
| 26 | Warp yarn |
| 28, 29 | Roller |
| 30 | Compressor |
| 32 | Tank |
| 33 | Valve |
| 34 | Tube |
| 36 | Pipe assembly |
| 38 | Controller |
| 40 | Warp yarn pipe |
| 41 | Air pipe for weft yarn |
| 42 | Air pipe for warp yarn |
| 44, 45 | Base |
| 60 | Knitted fabric |
| 62 | Normal section |
| 64 | Flechage section |
| 65, 66 | Line |
| 68 | Weft yarn |
| 70 | Knitted fabric |
| 72 | Weft yarn |

**Claims**

1. A warp yarn positive feeding device (4) for a knitting machine (2) comprising a plurality of warp yarn pipes (40) through which warp yarns (26) pass and are fed to a trick gap of the knitting machine (2), **characterized in that** the warp yarn positive feeding device (4) further comprises:

   a powered roller mechanism (18) that includes a plurality of driving rollers (22) for drawing warp yarns (26) from a plurality of warp yarn sources (25) and positively feeding the drawn warp yarns (26), each driving roller (22) drawing at least one warp yarn (26) by a required length; and
   an air injection mechanism for feeding, by blowing an air flow into the warp yarn pipes (40), the warp yarns (26) drawn by the powered roller mechanism (18) to the trick gap of the knitting machine (2).

2. The warp yarn positive feeding device (4) for a knitting machine (2) according to claim 1, **characterized in that** it further comprises:

   a controller (38) that controls the powered roller mechanism (18) such that the driving rollers (22) feed the warp yarns (26) of a required length according to knitting.

3. The warp yarn positive feeding device (4) for a knitting machine (2) according to claim 1 or 2, **characterized in that** the air injection mechanism includes a plurality of air pipes (42) through which air is injected into the warp yarn pipes (40), and each driving roller (22) is configured to feed a plurality of warp yarns (26) so that the fed warp yarns (26) are inserted into the respective warp yarn pipes (40).

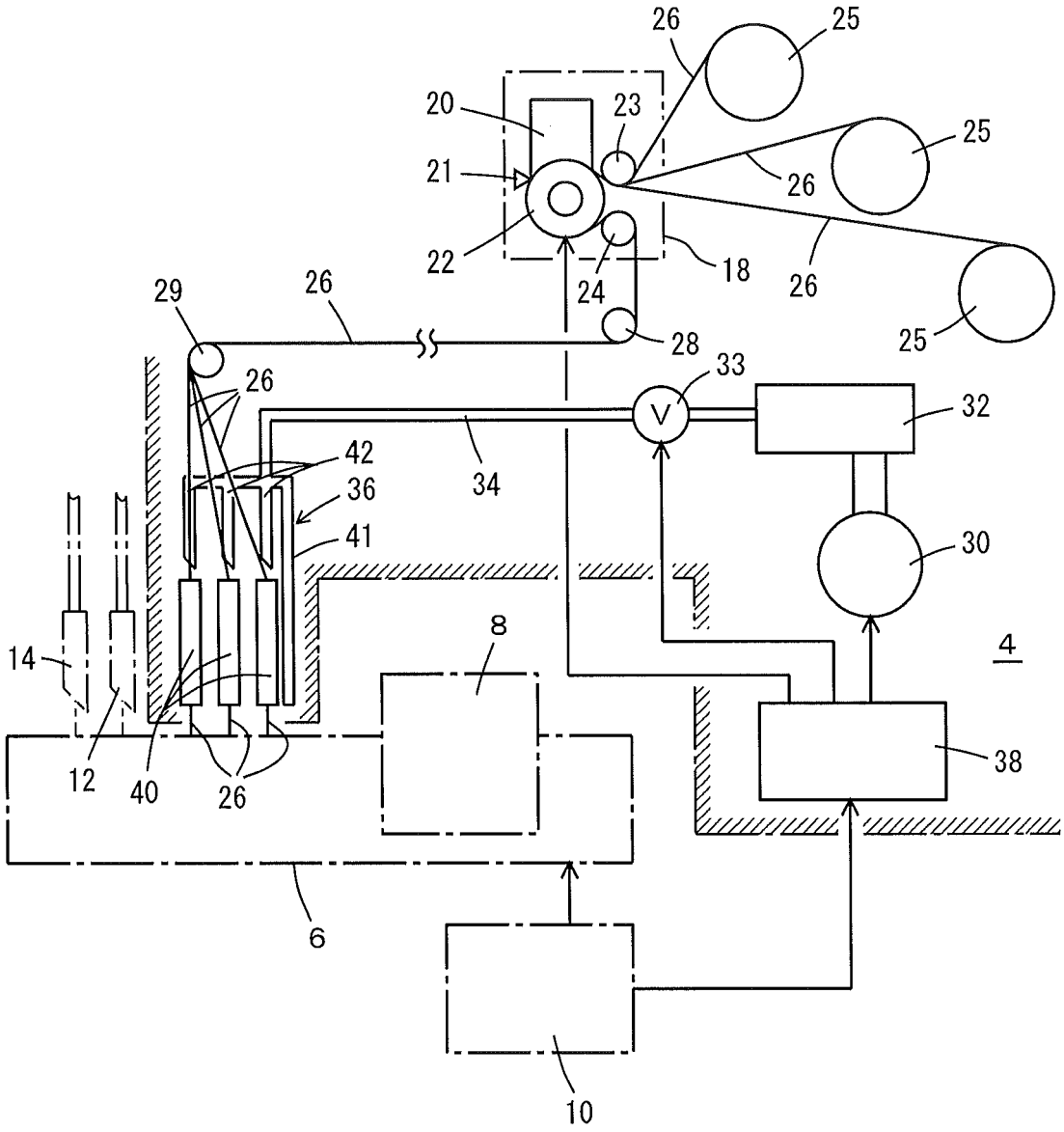
4. The warp yarn positive feeding device (4) for a knitting machine (2) according to claim 3, **characterized in that** the air injection mechanism further includes an air pipe (41) for weft yarn through which air is blown into the trick gap from above so as to press a weft yarn when the weft yarn is inserted in a course direction.

5. The warp yarn positive feeding device (4) for a knitting machine (2) according to any one of claims 2 to 4, **characterized in that** a pulsed air flow is repeatedly blown into the warp yarn pipes (40) from the air pipes (42).

6. The warp yarn positive feeding device (4) for a knitting machine (2) according to any one of claims 2 to 5, **characterized in that** the powered roller mechanism (18) is controlled such that warp yarns (26) of a required length are positively fed to the trick gap when the knitting machine (2) knits a three-dimensional knitted fabric.

7. A knitting machine (2) comprising the warp yarn positive feeding device (4) for a knitting machine (2) according to any one of claims 1 to 6.

FIG. 1


26
25
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V
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41
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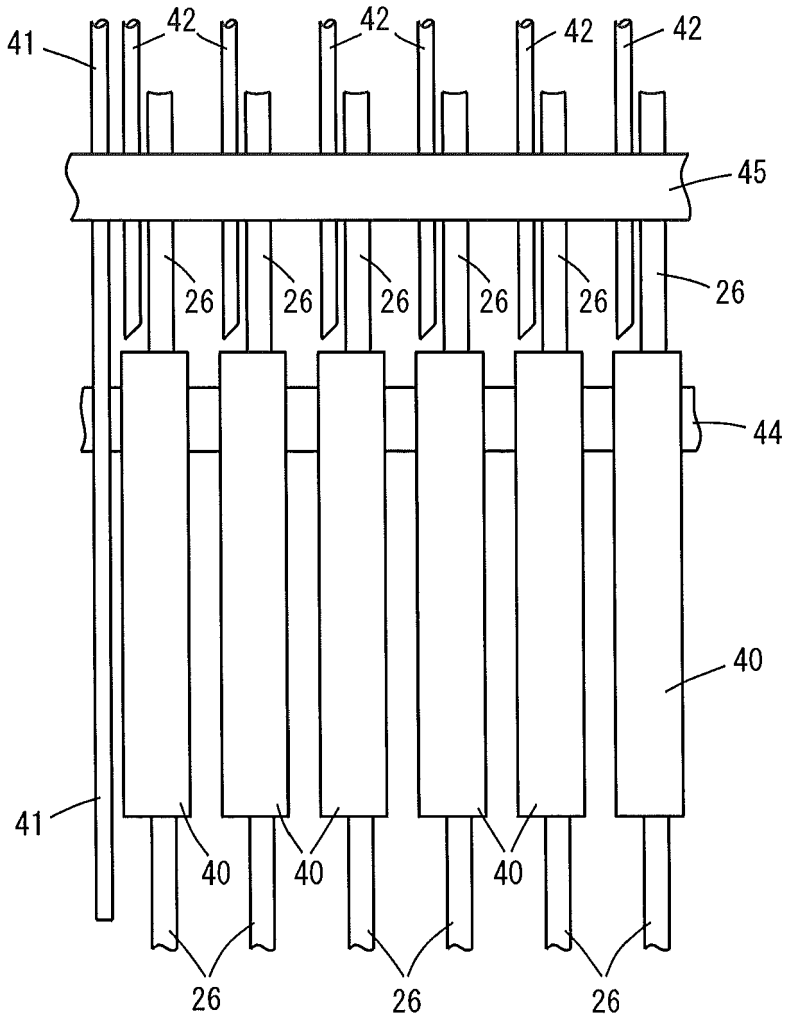
2

FIG. 2




36

FIG. 3

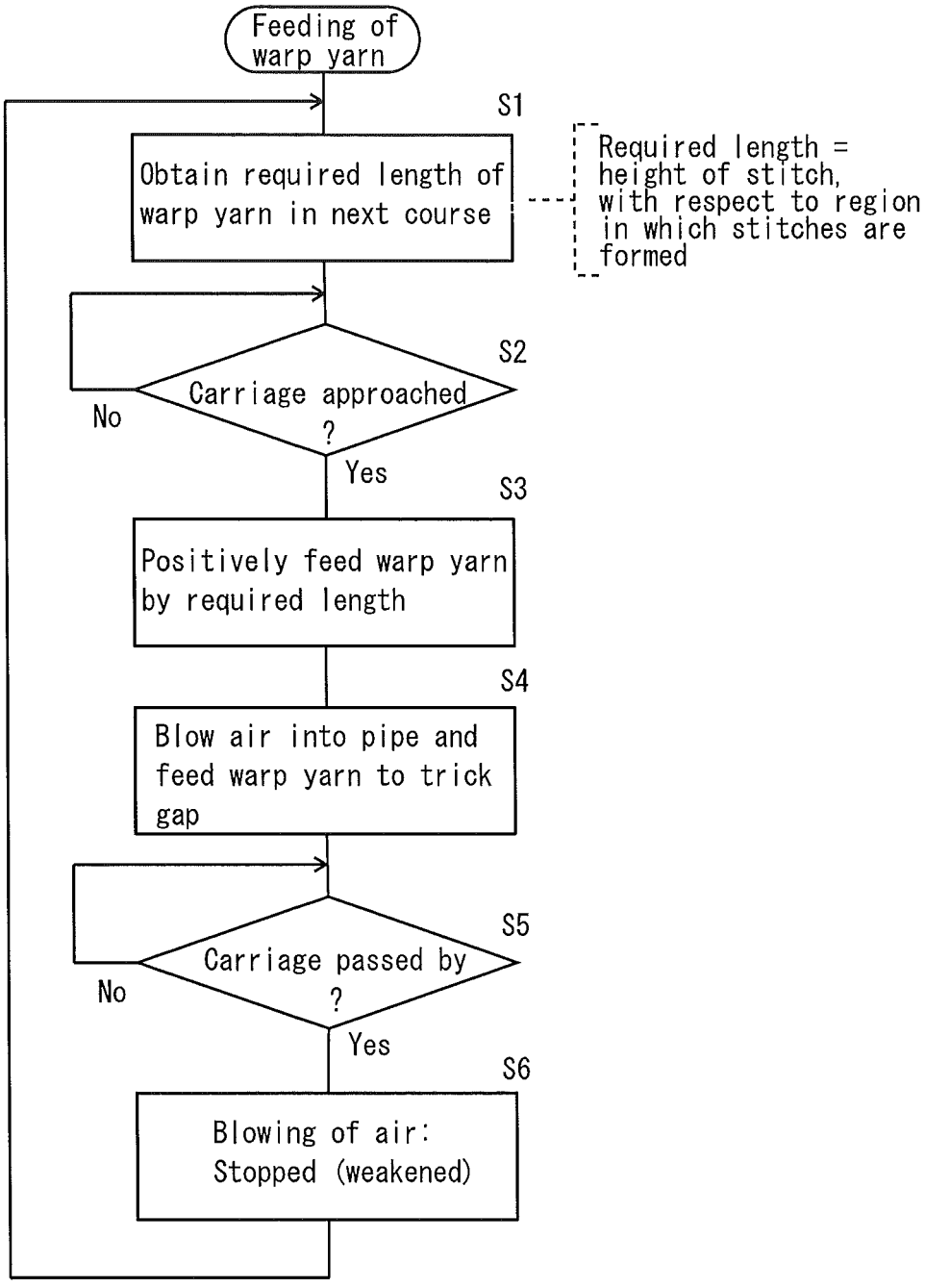

Feeding of warp yarn
S1
Obtain required length of warp yarn in next course
Required length = height of stitch, with respect to region in which stitches are formed
S2
Carriage approached ?
No
Yes
S3
Positively feed warp yarn by required length
S4
Blow air into pipe and feed warp yarn to trick gap
S5
Carriage passed by ?
No
Yes
S6
Blowing of air: Stopped (weakened)

FIG. 4

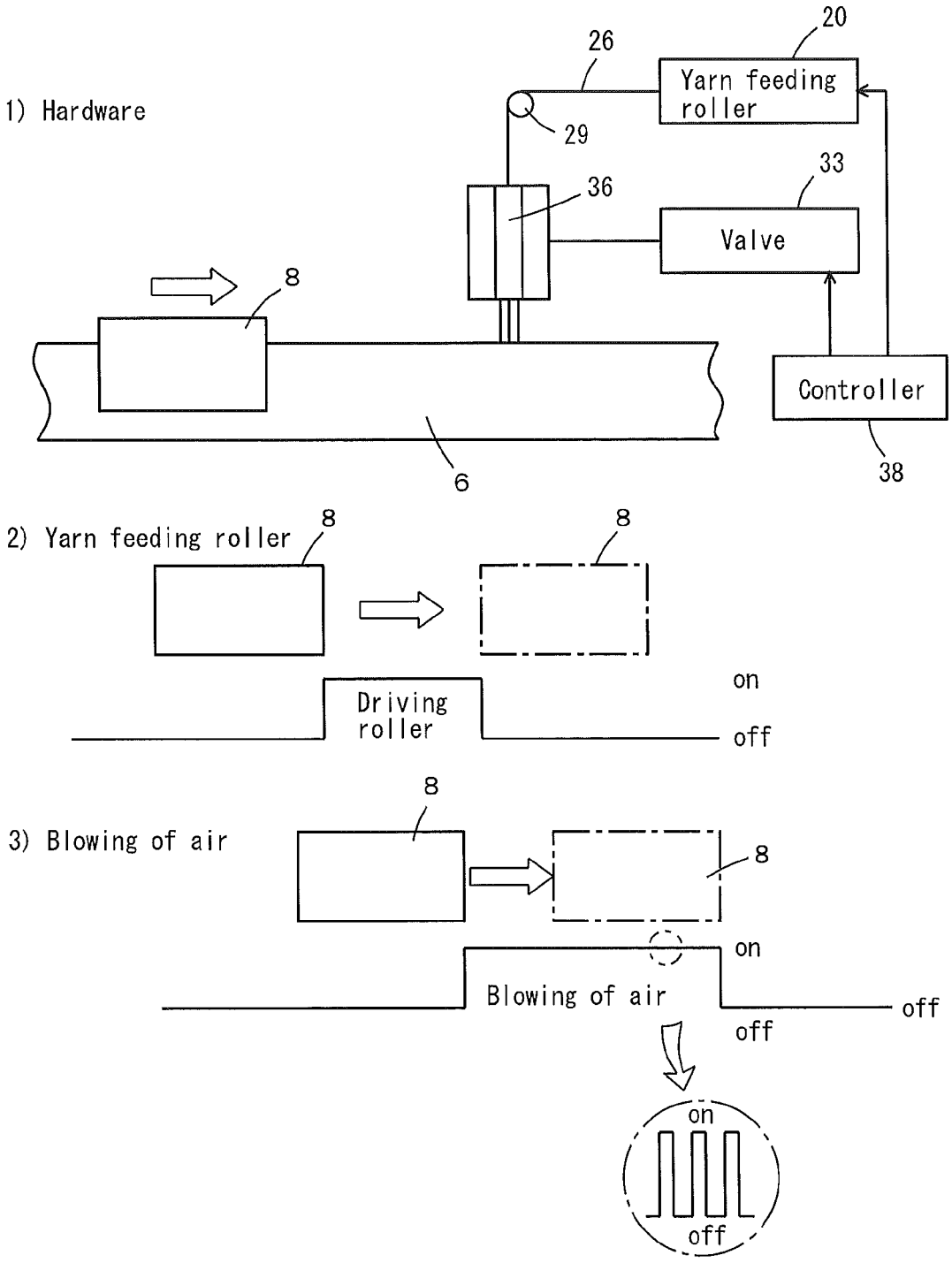

1) Hardware
20
26
Yarn feeding roller
29
33
36
Valve
8
Controller
6
38
2) Yarn feeding roller
8
8
on
Driving roller
off
3) Blowing of air
8
8
on
Blowing of air
off
off
on
off

FIG. 5

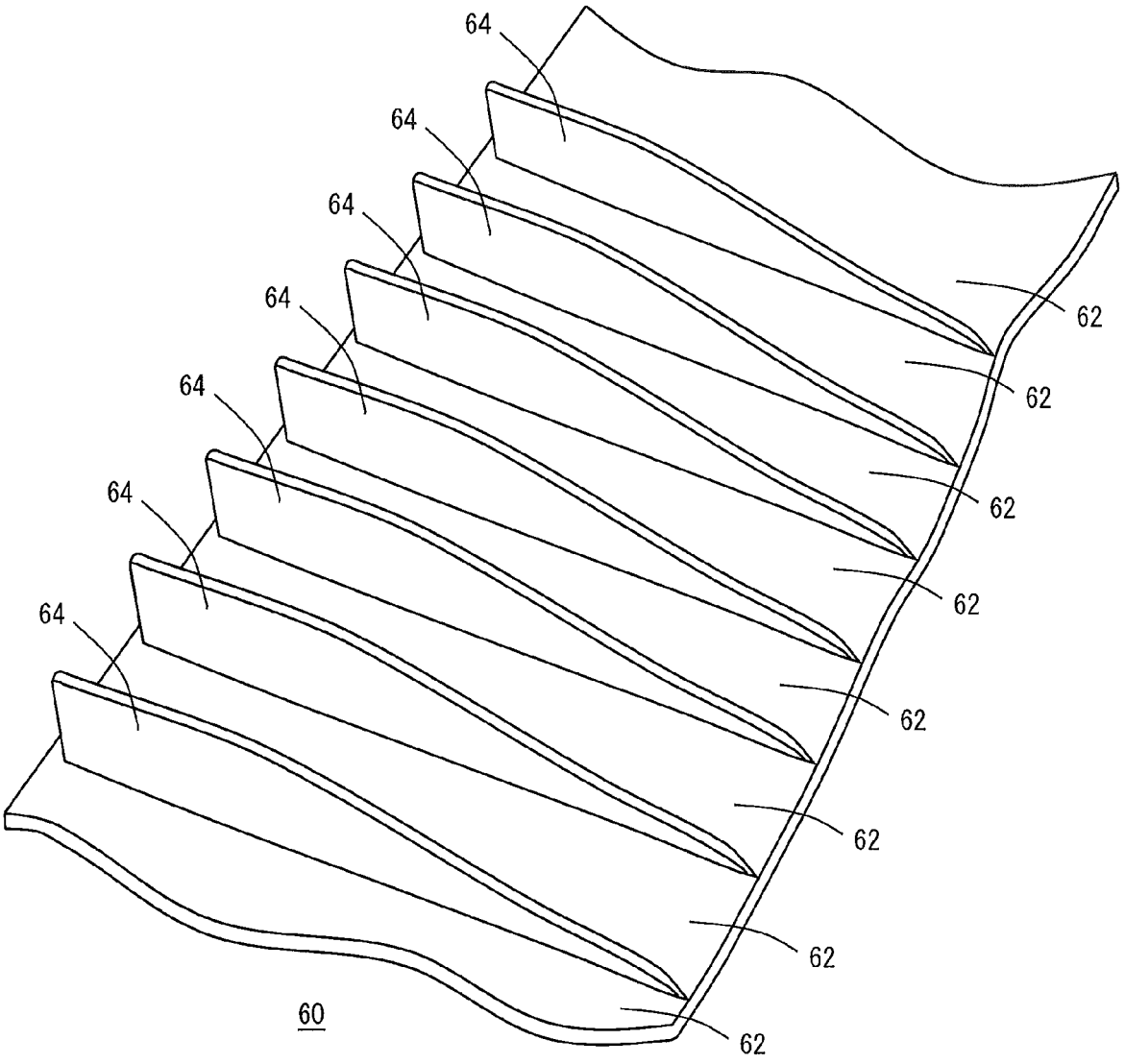


FIG. 6

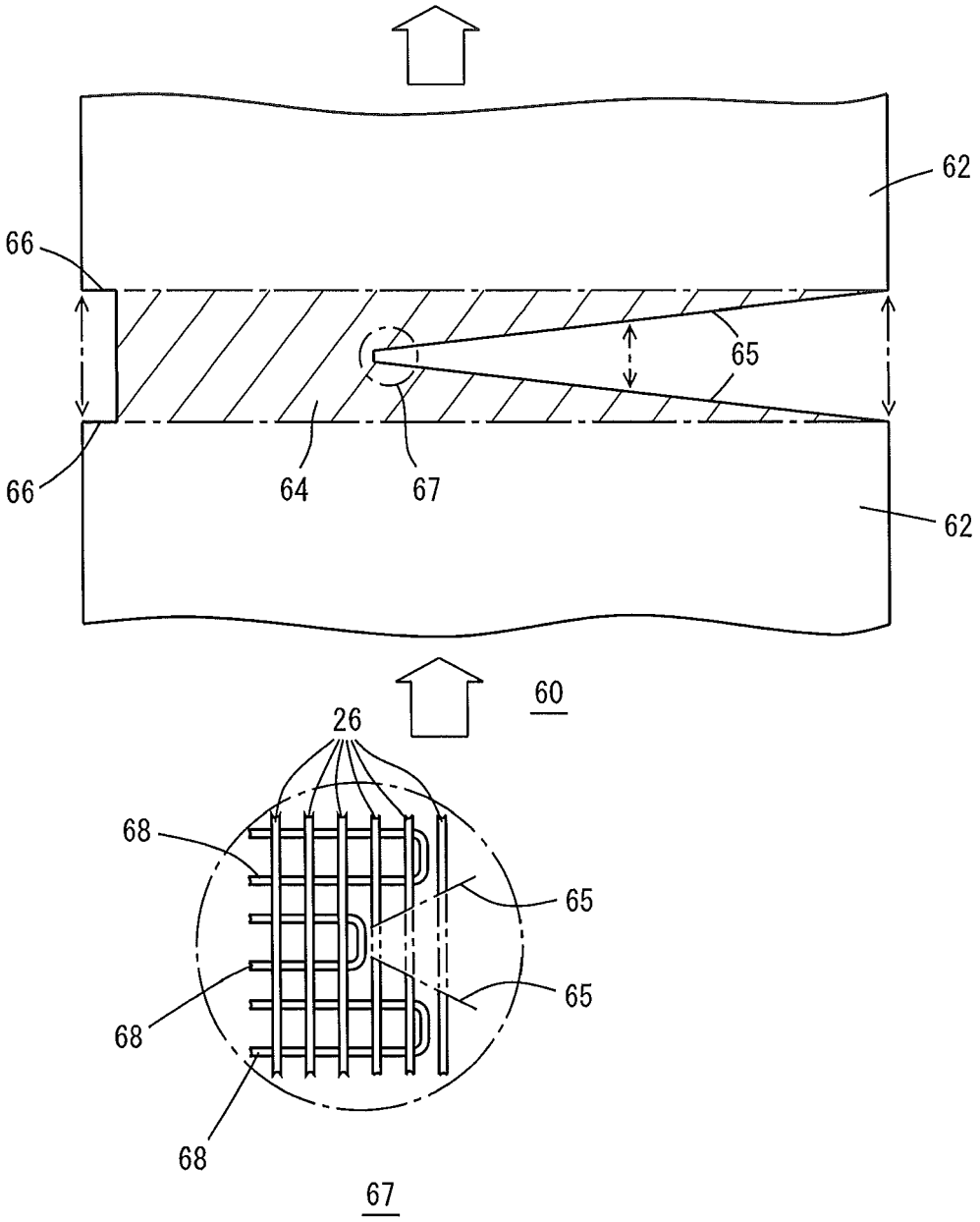
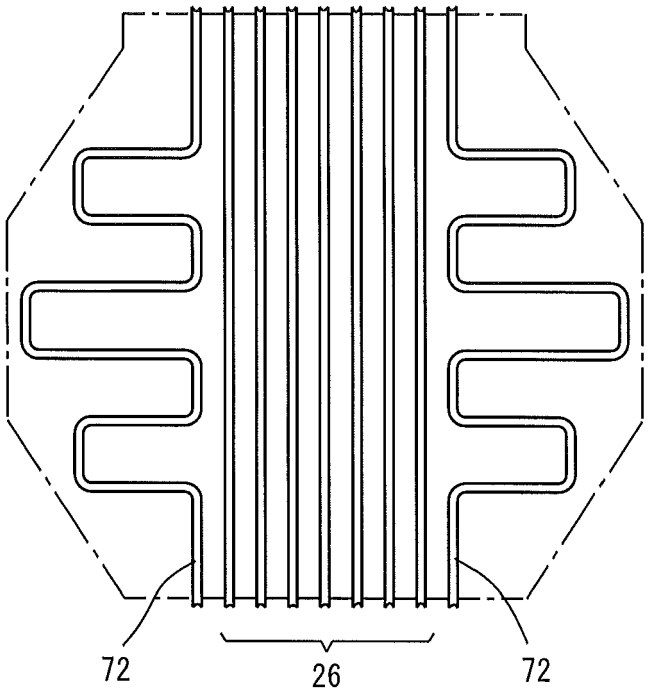


FIG. 7



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Application Number
EP 14 18 1601

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