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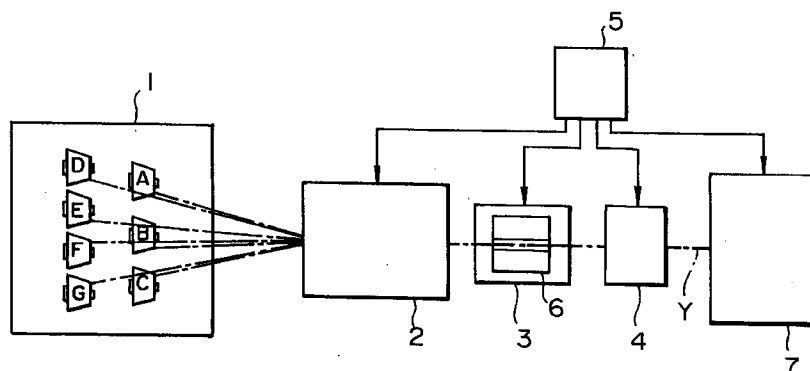
**(54) SYSTEM FOR TREATMENT OF YARN**

(57) A yarn processing system capable of producing knitted goods having high quality and no knots in the case where knitted goods are to be produced by combining yarns of differing colors or the like.

A device where a yarn selector 2 that is able to freely select from supply yarns is positioned between a knitting machine 7 and a supply yarn part 1 having a

plurality of types of supply yarn packages A-G for a single knitting machine 7, a yarn piecing part 3 that pieces the yarn Y from the knitting machine 7 side and yarn from the yarn selector 2 side is linked between the knitting machine 7 and yarn selector 2, and an air type yarn piecing device 6 is arranged on that yarn piecing part3.

**FIG. 1**



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## Description

### Technical Field

The present invention relates to a yarn processing system on a knitting machine that produces knitted goods such as socks or the like.

### Background Art

There exists a system that supplies yarn where a plurality of types of yarns of differing colours or the like are prepared on a knitting machine and yarn piecing is performed by selecting the yarns at random or regularly. Conventionally, a mechanical knoter that produces knots has been utilized as a yarn piecing device on such a system.

### Problems to be solved by the Invention

However, on the above mentioned yarn processing system, as a knoter that forms knots is used as a yarn piecing device, there are many knots and when the knot thickness is large, the knot catches on the knitting needle during the knitting process and even if the yarn does not break, the knot projects from the surface of the produced knitted goods thus drastically lowering the product value. Furthermore, there has been an increase in the process whereby the yarn end of the knot is cut but if cut too much, the knot may become unwound.

In order to solve the problems existant on a conventional device, it is an object of the present invention to propose a yarn processing system capable of producing knitted goods having high quality and no knots when knitted goods are to be produced by combining yarns of differing colors.

### Means for solving the problems

In order to achieve the aforementioned object, a first aspect of the present invention is the positioning of a yarn selector between the knitting machine and a supply yarn part having a plurality of types of supply yarns for a single knitting machine, a yarn piecing part that pieces the yarn from the knitting machine side and yarn from the yarn selector side linked between the knitting machine and yarn selector, and an air type yarn piecing device arranged on that yarn piecing part. Yarn piecing is performed without the formation of knots by yarn piecing by twisting together pairs of yarn ends by an air current thus producing high quality knitted goods where the knots do not project from the surface.

Further, a yarn storage part is linked between the knitting machine and yarn piecing part. Accordingly, while yarn piecing is being performed by the yarn piecing part, a predetermined volume of yarn is supplied to the knitting machine from the yarn storage part corresponding to the operation speed of the knitting machine even if yarn is not supplied to the yarn storage part from

the yarn piecing part side and continuous operation is possible without stoppage of the knitting machine.

Yet further, it is possible to change the volume of stored yarn in the storage part in response to the operation speed of the knitting machine. Accordingly, each part of the operations may be controlled such that the yarn necessary at the knitting process of the knitting machine is supplied to knitting machine from the plurality of types of supply yarn of the supply yarn part by yarn piecing.

### Brief Description of the Drawings

Figure 1 is a block diagram showing the yarn processing system being one embodiment of the present invention. Figure 2 is plan view showing an example of application of an air type yarn piecing device of the yarn piecing part. Figure 3 is side view showing a rotating type storage drum being an example of a device provided in the yarn storage part.

### Detailed Description of the Preferred Embodiment

Hereafter, an embodiment of the present invention will be described with reference to the drawings.

Figure 1 shows an embodiment of the yarn processing system of the present invention. Figure 1 is a block diagram showing the system arrangement comprising mainly a supply yarn part 1, yarn selector 2, yarn piecing part 3, yarn storage part 4 and knitting machine 7. Each part is arranged from the knitting machine 7 in the following order; yarn storage part 4, yarn piecing part 3, yarn selector 2, supply yarn part 1. Each operation of the yarn selector 2, yarn piecing part 3 and yarn storage part 4 are completely controlled by a control part 5.

Hereafter, each part comprising the aforementioned system will be described.

The supply yarn part 1 is suitably arranged with a plurality of types of supply yarn packages A-G differing in colour for example which do not interfere with each other. The aforementioned supply yarn packages A-G have already been wound on a winder, consist of a yarn which has had yarn defects such as slub or the like removed having been dyed at a dying process and each of the aforementioned packages may be used on a knitting machine. The supply yarn packages A-G are supported by the required number of types of packages being mounted in a suitable position. The yarn of a single supply yarn package of among the supply yarn packages A-G is selected by the yarn selector 2, supplied to the knitting machine 7 via the yarn storage part 4 and knitted goods are produced.

The yarn end pulled from each supply yarn packages A-G of the supply yarn part 1 is held by the yarn selector 2 and the yarn end of one specific yarn of among the supply yarn packages A-G is selectively positioned in the yarn running position in accordance with commands from the control part 5. In short, each

yarn end of each yarn of the supply yarn packages A-G of the supply yarn part 1 is held in a standby position in a yarn end holding part (not shown in the drawings) and the yarn necessary for the knitted goods produced by the knitting machine 7 is positioned in a yarn running position by the yarn end holding part that holds that yarn in accordance with commands from the control part 5.

Then, when another yarn of the supply yarn package (for example B) instead of the yarn of the supply yarn package (for example A) of the supply yarn part 1 mid-supply is necessary for the knitted goods produced by the knitting machine 7, firstly, the running yarn of the supply yarn package A stops running upstream (supply yarn part 1 side) from the yarn storage part 4 in accordance with the commands of the control part 5. The stationary yarn of the supply yarn package A is then forcibly cut by a cutting device 47 (Figure 2) of the yarn selector 2 at the yarn selector 2. The yarn end of the cut yarn of supply yarn package A of the supply yarn part 1 side is returned to a standby position by removing the yarn end holding part of that yarn from the yarn running position and the yarn end holding part 33 (Figure 2) that holds the yarn end of another supply yarn package B positions the yarn end of the supply yarn package B in the yarn running position. The positioned yarn end of the supply yarn package B is pieced to the supplied yarn storage part 4 side yarn end of the supply yarn package A by the yarn piecing part (described later) and thus the yarn of the supply yarn package B is supplied to the knitting machine 7. It should be noted that in figure 1, an example using 7 supply yarns has been described but this number may be freely changed.

As described above, when a yarn supplied to the knitting machine 7 is to be exchanged from the supply yarn package A to the supply yarn package B, the yarn piecing part 3 positioned next to the yarn selector 2 holds the yarn end of the yarn storage part 4 side yarn of the supply yarn package A forcibly cut at the yarn selector 2 and also the yarn end of the desired type of the newly supplied supply yarn package B, cuts them to a predetermined length and joins the yarn ends. The yarn piecing part 3 has a yarn end cutting device (described later), a yarn piecing device 6 and a guide device for guiding the yarn end into a fixed position of the yarn piecing device and the like. An air type yarn piecing device is used as the yarn piecing device 6.

An example of the air type yarn piecing device of the yarn piecing part is shown in figure 2.

The yarn piecing part 3 basically comprises the yarn piecing member 37, yarn pressing device 38, untwisting nozzle 39,40, yarn moving lever 48, yarn end cutting device 41,42, yarn clamp device 43,44, a first suction pipe 45 that sucks and holds the yarn storage part 4 side yarn end, a second suction pipe 46 that sucks and holds the yarn selector 2 side yarn end and a rotating arm 29 that guides the yarn selector 2 side yarn end to the yarn piecing part 37.

A cylindrical yarn piecing hole 49 is arranged in the center of the yarn piecing member 37, a slit used for

inserting the yarn from outside is formed in the yarn running direction, and furthermore, a blowing nozzle that blows compressed air is arranged in the vicinity of that slit and facing the yarn piecing hole 49. The untwisting nozzle 39,40, yarn moving lever 48, yarn end cutting device 41,42 and yarn clamp device 43,44 are executed in a predetermined order by a cam system (not shown in the drawings). The rotating arm 29 is supported so as to be able to freely rotate on a frame 50. The rotating arm 29 is approximately L-shaped, a fan shaped gear 55 engages with a spur wheel 54 arranged on the shaft 53 mounted on the arm and the fan shaped gear 55 is driven by a program cam that is driven by orders from the control part 5, in short a yarn piecing command. 56-61 are yarn guides.

Next, the operations of the yarn piecing part 3 will be described.

As mentioned above, when the yarn supplied to the knitting machine 7 is to be exchanged, firstly the yarn receiving operations of the yarn storage part 4 stop due to a command from the control part 5 and the running of yarn upstream from the yarn storage part 4 stops. The stationary yarn is then held in the yarn end holding part (not shown in the drawings) of that yarn of the yarn selector 2 and forcibly cut by the yarn cutting device 47 of the yarn selector 2. The yarn selector 2 side yarn end is held in the yarn end holding part (not shown in the drawings), is removed from the yarn running position and is sent to a standby position. Then the yarn end YV of the new running yarn is sent to the yarn running position by the yarn end holding part 33 that was holding the yarn end YV. Conversely, the yarn end YP of the yarn storage part 4 side yarn forcibly cut by the yarn cutting part 47 of the yarn selector 2 is held by suction in the suction pipe 45. The yarn end YP is clamped in a position a fixed distance from the yarn end tip by the yarn clamp device 43 while being suction held in the suction pipe 45, is cut by the yarn cutting device 41 and yarn end untwisting is performed on the yarn end in the free state by being sucked by the untwisting nozzle 39.

The yarn end YV sent to the yarn running position by the yarn end holding part 33 is released from the yarn end holding part 33 and then held in the movable piece 32 of the yarn gripper 30 on the tip of the rotating arm 29. The rotating arm 29 then holds the yarn end YV in the movable piece 32 of the yarn gripper 30 at the tip and rotates, a roller arranged on a part of the movable piece 32 of the yarn gripper 30 couples with a cam plate 52, the movable piece opens, the held yarn selector 2 side yarn end is released and sucked into the suction pipe 46. In short, the rotating arm 29 rotates, the yarn selector 2 side yarn end YV is moved above the yarn piecing member 37 while the yarn from the supply yarn package is being pulled, the rotating arm 29 couples with the cam plate 52 in a position rotated by approximately 180 ° and as shown by the yarn YU indicated by a broken line, is sucked and held in the suction pipe 46.

The yarn end YU is clamped by the clamp device 44 while being suction held by the suction pipe 46, is cut

by the yarn end cutting device 42 and an untwisting action is effected by the free yarn end being sucked into the untwisting nozzle 40. Furthermore, the yarn end inside the untwisting nozzles 39,40 are pulled by the rotation movement of the yarn moving lever 48 and the yarn ends are pieced together by the action of compressed fluid blown from the blowing nozzle by their overlapping in the yarn piecing hole 49 of the yarn piecing member 37. In this way, the yarn piecing preparations are performed by each of the yarn ends YP,YU being positioned in a position shown by the broken line and solid line of figure 2 and yarn piecing is performed by the aforementioned actions. Once the control part 5 has detected a yarn piecing completion and the yarn receiving operations of the yarn storage part 4 are restarted, the stationary yarn upstream from the yarn storage part 4 starts running again and the yarn supplied to the knitting machine 7 is exchanged.

It should be noted that in order for the yarn end YP to be sucked smoothly into the suction pipe 45, it is preferable for the open end of the suction pipe 45 to be facing upwards so as to receive the yarn end from below. If the distance between the yarn cutting device 47 of the yarn selector 2 and the suction pipe 45 is too short, the probability of failure of suction capture of the yarn end increases and the suction holding strength after suction capture is weakened as the length of the yarn end sucked by the suction pipe 45 is short. In short, the force exerting tension on the yarn is weak and this may lead to defective yarn piecing operations. If the distance between the yarn cutting device 47 of the yarn selector 2 and the suction pipe 45 is too long, the amount of excessive yarn cut by the yarn cutting device 47 increases and is undesirable. As a result, it is preferable to make this distance as short as possible within the range where the suction holding force is not excessive or insufficient.

Furthermore, the yarn storage part 4 is positioned in continuance with the yarn piecing part 3. The yarn storage part 4 is connected to the knitting machine 7. A predetermined amount of the yarn Y supplied to the yarn storage part 4 from the yarn piecing part 3 side is stored in the yarn storage part 4 and supplied to the knitting machine 7 from the yarn storage part 4. Due to this, continuous operation is possible without stopping the knitting machine 7 during yarn piecing by the yarn piecing part 3 even if yarn Y is not supplied to the yarn storage part 4 from the yarn piecing part 3 side. Also, the yarn storage part 4 is also connected to the control part 5 and as it operates by commands from the control part 5, yarn Y corresponding to the operation speed of the knitting machine 7 is supplied to the knitting machine 7 from the yarn storage part 4 without the yarn supplied to the knitting machine 7 changing in tension with respect to the predetermined tension.

Figure 3 is a side view showing the rotating type storage drum being an example of the device positioned in the yarn storage part 4. The rotating type storage drum 15 is a rotating member having a flange 15a, trunk

15b and groove 15c, rotates by a pressure roller 15d being pressed in contact with the flange 15a and stores yarn Y as a wound state in the trunk 15b. The yarn Y is stopped in the groove 15c by an air current inside a blow cover 15e. A motor M4 is connected to the flange 15a and rotates the drum 15. The motor M4 is linked to the control part 5 and is controlled so that a predetermined amount of yarn Y is stored in the trunk 15b.

The yarn supplied to yarn storage part 4 from the yarn piecing part 3 side is pressed by the pressure roller 15d onto the flange part 15a, a predetermined amount is stored in a wound state in the trunk 15b and then supplied to the knitting machine 7. When yarn piecing is to be performed by the yarn piecing part 3 and yarn Y is not supplied to the storage drum 15 from the yarn piecing part 3, the motor M4 stops and a predetermined amount of yarn Y stored in the trunk 15b in a wound state is continuously supplied to the knitting machine 7. As a result, continuous operation is possible without stoppage of the knitting machine 7. Furthermore, the motor M4 is connected to the control part 5 and as it is controlled by the control part 5, a predetermined amount of yarn corresponding to the operation speed of the knitting machine 7 is supplied to the knitting machine 7 from the yarn storage part 4 without the yarn Y supplied to the knitting machine 7 from the trunk 15b of the rotating type storage drum 15 changing in tension with respect to the predetermined tension.

The predetermined amount of yarn Y required by the knitting process of the knitting machine 7 is yarn pieced from the plurality of types of supply yarns A-G of the supply yarn part 1 to the knitting machine 7 by the yarn piecing device 6 of the yarn piecing part 3 and the control device 5 that controls the operations such as the selection of the yarn type and yarn supply length of each part is arranged such that a predetermined amount of yarn Y is stored in the yarn storage part 4 and supplied. The control device 5 may use a relay sequence or microcomputer or the like. In short, when the color of the yarn is to be changed in the knitting process of the knitted goods being produced by the knitting machine 7, the control device 5 controls the selection of the yarn where the type of yarn supplied by the supply yarn part 1 is changed by the yarn selector 2, the yarn piecing of the yarn when there are changes by the yarn piecing device 6 of the yarn piecing part 3 and the operation and timing of the storage of the yarn in the rotating type storage drum 15 and rotating guide type storage drum of the yarn storage part 4.

Hereafter, the actions of each part as described above will be described as actions of the entire system. Firstly, a yarn of supply yarn package A for example is selected by the yarn selector 2 from the supply yarn packages A-G supported on the supply yarn part 1 and supplied to the knitting machine 7 via the yarn piecing part 3 and yarn storage part 4 for the knitted goods produced by the knitting machine 7. At this point, a predetermined amount of yarn is stored in the yarn storage part 4 and due to the control part 5, the amount of the

yarn Y supplied to the knitting machine 7 from the yarn storage part 4 corresponds to the operation speed of the knitting machine 7 without the tension being changed with respect to the predetermined tension.

Next, when there is to be an exchange to, for example, supply yarn package B for the knitted goods produced by the knitting machine 7, the yarn receiving operations of the yarn storage part 4 are stopped in accordance with the commands from the control part 5, the running yarn of supply yarn package A upstream stops and is forcibly cut by the cutting device of the yarn selector 2. The yarn of supply yarn package A of the supply yarn part 1 side cut at the yarn selector 2 is exchanged for the supply yarn package B. Then at the yarn selector 2, the cut yarn of the supply yarn package A of the yarn storage part 4 side and the exchanged yarn of the supply yarn package B are held by the yarn piecing part 3 and pieced together after being cut to a predetermined length. During the yarn piecing by the yarn piecing part 3, a predetermined amount of yarn stored in the yarn storage part 4 is supplied to the knitting machine 7 in accordance with the commands from the control part 5 even if yarn Y is not supplied to the yarn storage part 4 thus continuous operation is possible without stoppage of the knitting machine 7. When the control part 5 detects completion of the yarn piecing, the yarn receiving actions of the yarn storage part 4 are restarted, the stationary yarn upstream from the yarn storage part 4 starts running again and the yarn supplied to the knitting machine 7 is switched from the supply yarn package A to the yarn of supply yarn package B. Similar to the above, during supply to the knitting machine 7, any desired yarn from the supply yarn packages A-G of the supply yarn part 1 may be exchanged and supplied to the knitting machine 7.

Furthermore, as the yarn selector 2, yarn piecing part 3, yarn storage part 4 and knitting machine 7 are connected to the control part 5, all the operations of the yarn selector 2, yarn piecing part 3, yarn storage part 4 and knitting machine 7 may be controlled collectively. Accordingly, the desired yarn from the supply yarn packages A-G may be supplied to the knitting machine 7 at the desired timing without stoppage of the knitting machine 7 and providing a stable knitting machine 7. The yarn pieced by the aforementioned system is yarn piecing by an air type yarn piecing device thus the joint is almost indistinguishable from the a single yarn. It should be noted that the color arrangement and length and the like may be set irregularly or cyclically.

#### Effects of the Invention

Due to the use of an air type yarn piecing device, in the case of a knitter that forms knots, problems such as when the knot catches on knitting needle during the knitting process, the yarn breaking or the knot projecting from the surface of the produced knitted goods thus drastically lowering the product value may be prevented. Furthermore, there has been an increase in the

process whereby the yarn end of the knot is cut but the problem whereby if cut too much the knot may become unwound is prevented.

Furthermore, a predetermined amount of yarn corresponding to the operation speed of the knitting machine is supplied to the knitting machine from the yarn storage part and continuous operation is possible without stopping the knitting machine 7 during yarn piecing by the yarn piecing part 3 even if yarn Y is not supplied to the yarn storage part 4 from the yarn piecing part 3 side.

Yet further, a predetermined amount of yarn is stored in the yarn storage part and there is no change to the tension of the yarn supplied to the knitting machine from the yarn storage part due to the control part with respect to the predetermined tension corresponding to the operation speed of the knitting machine. A predetermined amount of yarn stored in the yarn storage part is supplied to the knitting machine in accordance with instructions from the control part during the yarn piecing by the yarn piecing part without the yarn being supplied to the yarn storage part thus continuous operation is possible without stopping the knitting machine 7.

#### Claims

1. A yarn processing system that positions a yarn selector that is able to freely select a supply yarn between a supply yarn part having a plurality of types of supply yarn for a single knitting machine and a knitting machine, where yarn piecing part that pieces a knitting machine side yarn and yarn selector side part yarn between the knitting machine and yarn selector, and arranged with an air type yarn piecing device in the yarn piecing part.
2. A yarn processing system as in claim 1, wherein a yarn storage part is connected between the knitting machine and yarn piecing part.
3. A yarn processing system as in claim 2, wherein the yarn storage quantity of the storage part may be changed in response to the operation speed of the knitting machine.

FIG. 1

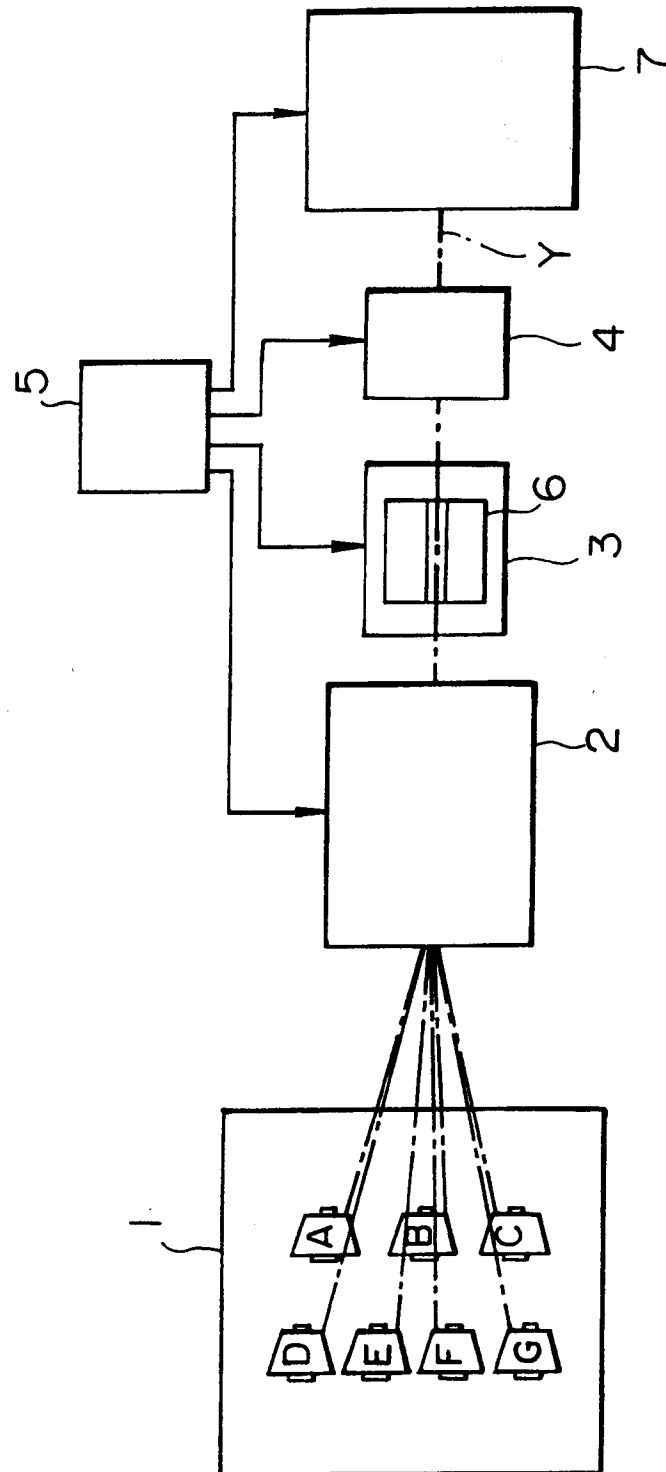


FIG. 2

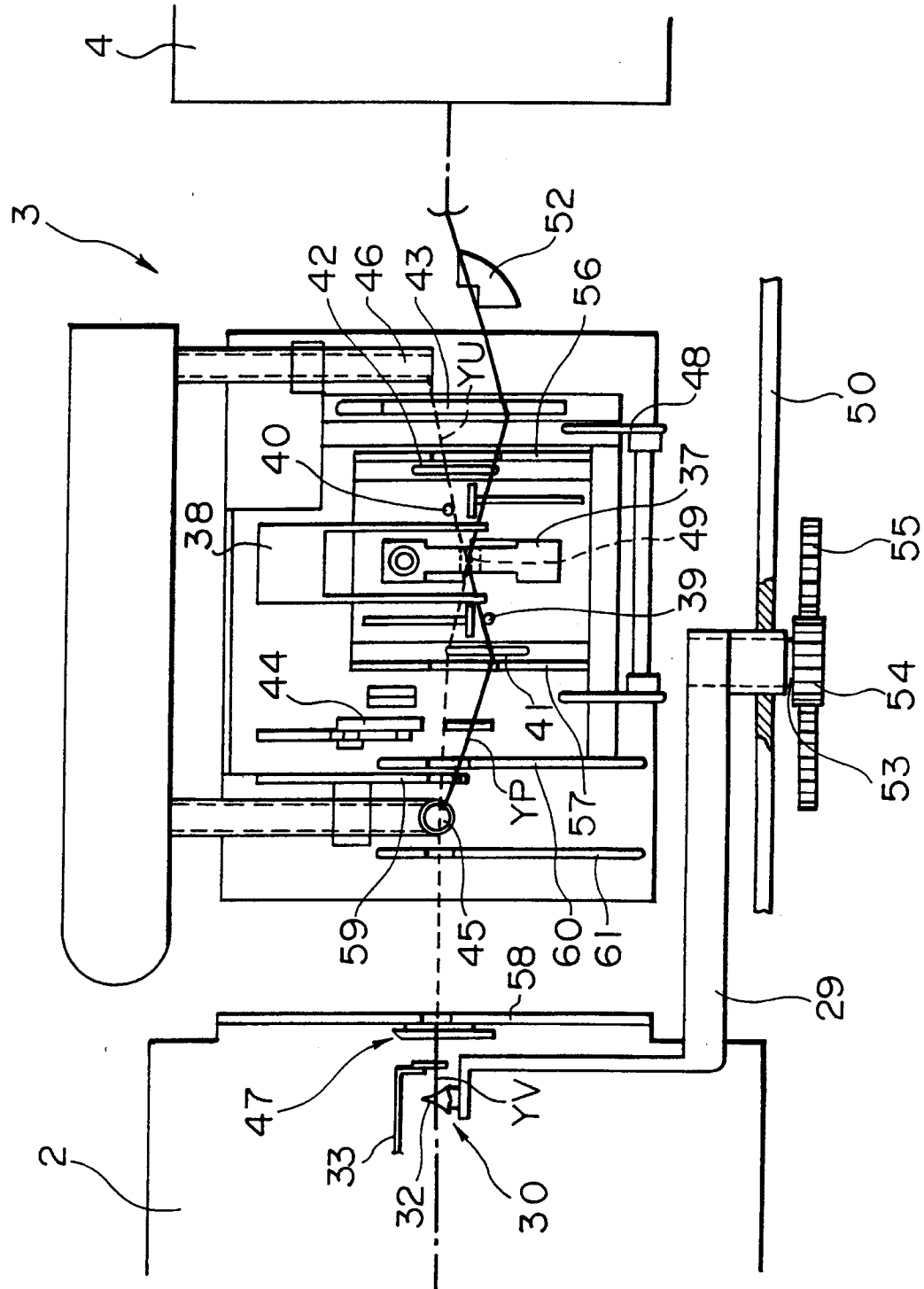
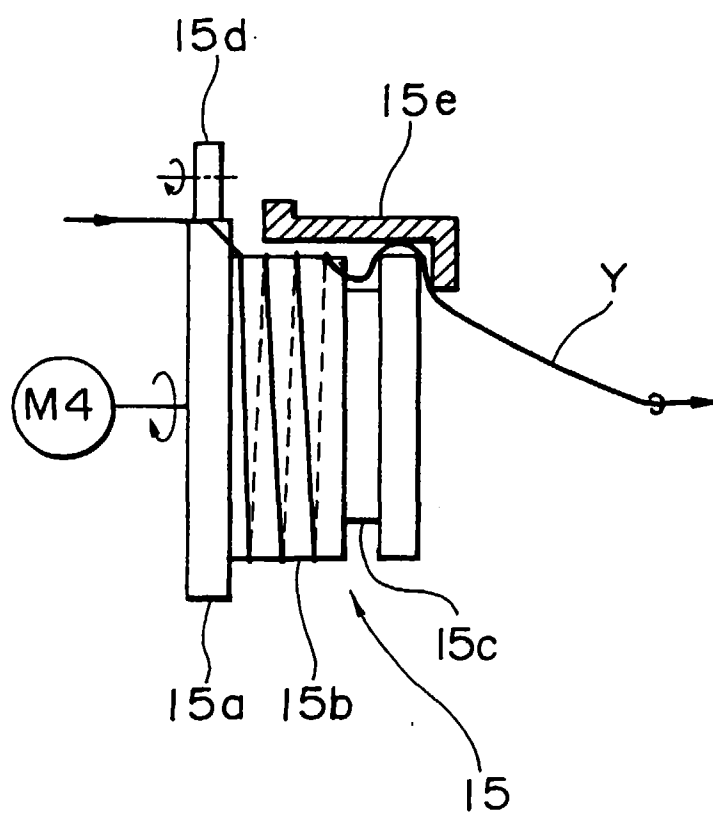


FIG. 3





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP96/03531

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl <sup>6</sup> D04B15/62 According to International Patent Classification (IPC) or to both national classification and IPC											
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) Int. Cl <sup>6</sup> D04B15/38-15/62, D04B35/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926 - 1996 Kokai Jitsuyo Shinan Koho 1971 - 1996 Toroku Jitsuyo Shinan Koho 1994 - 1996 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)											
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>JP, 51-24011, B1 (Unitika Ltd.), July 21, 1976 (21. 07. 76), Page 1, right column, lines 13 to 37 (Family: none)</td> <td>1, 2</td> </tr> <tr> <td>A</td> <td>JP, 51-24011, B1 (Unitika Ltd.), July 21, 1976 (21. 07. 76), Page 1, right column, lines 13 to 37 Page 2, left column, lines 17 to 25 (Family: none)</td> <td>3</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	JP, 51-24011, B1 (Unitika Ltd.), July 21, 1976 (21. 07. 76), Page 1, right column, lines 13 to 37 (Family: none)	1, 2	A	JP, 51-24011, B1 (Unitika Ltd.), July 21, 1976 (21. 07. 76), Page 1, right column, lines 13 to 37 Page 2, left column, lines 17 to 25 (Family: none)	3
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.											
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Date of the actual completion of the international search February 20, 1997 (20. 02. 97)		Date of mailing of the international search report March 4, 1997 (04. 03. 97)									
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.		Authorized officer Telephone No.									

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