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(11) **EP 1 077 275 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.02.2001 Bulletin 2001/08

(51) Int. Cl.⁷: **D02H 1/00**, D02H 13/04,
B65H 69/00

(21) Application number: **00114073.0**

(22) Date of filing: **06.07.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **14.07.1999 JP 20007299**

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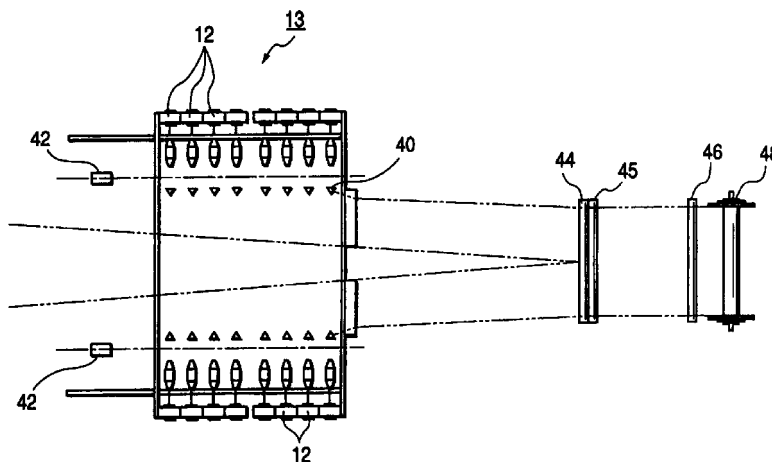
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(54) **Apparatus for detecting knotting state in creel**

(57) A creel 13 for arranging a large number of yarn-feeding bobbins has a nipping member 38 for holding an end of yarn led out of a newly placed yarn-feeding bobbin 12, a disk tensioner 40 for holding an end of yarn which is led out of an old yarn-feeding bobbin and which remains on the creel 13 at a predetermined position on the downstream side of the nipping member 38, and a knoter 42 for automatically knotting the two held yarns at a position between the two holders. There are further

provided tension-applying means 15 and 34 for bringing a tension-applying lever 18 into contact with the knotted yarns 16 between the two holders by driving to thereby apply a predetermined amount of tension to the knotted yarns 16. There are further provided a detection piece 24 and a proximity sensor 32 for detecting a state of tension applied to the yarns 16 by the tension-applying means 15 and 34.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to, in a creel pulling yarns out simultaneously from yarn-feeding bobbins placed on frames defining a plurality of lines for winding up a great deal of warp yarns on a beam, a technique for detecting whether knotting is perfect or not, when the knotting is performed on yarn led out of an old yarn-feeding bobbin remaining on the creel and yarn led out of a new yarn-feeding bobbin after exchange of the old yarn-feeding bobbin to the new yarn-feeding bobbin.

[0002] Heretofore, there has been used a creel which arranges a large number of yarn-feeding bobbins on frames in order to wind up hundreds of yarns or more like a sheet on a beam while pulling out the yarns. In such a creel, the work of exchanging a spent yarn-feeding bobbin to a new yarn-feeding bobbin after cutting yarn of the spent yarn-feeding bobbin while making the yarn of the spent yarn-feeding bobbin remain on the creel is required because yarn of a yarn-feeding bobbin is spent out by being pulled out of the yarn-feeding bobbin or for the purpose of exchanging the kinds of yarns.

[0003] For example, to shorten the time of stoppage due to the exchange of yarn-feeding bobbins, there is used a semi-magazine creel of the type in which a plurality of holders capable of placing the same number of yarn-feeding bobbins on either side of each frame extending vertically are provided so that the frame is rotated by 180° through a shaft to arrange new bobbins in predetermined opposite positions simultaneously. When simultaneous pulling-out of yarns from yarn-feeding bobbins on the use side (rear side) currently in use is completed, new yarn-feeding bobbins to be used next are preliminarily arranged in holders on the standby side (front side) currently not in use. At the time of exchange of supplied yarns, yarns of old yarn-feeding bobbins are cut at positions near the old yarn-feeding bobbins respectively. The frame is reversed by 180° so that new yarn-feeding bobbins placed on the front side of the frame are arranged opposite to the remaining yarn ends of the old yarn-feeding bobbins respectively. Then, leading ends of yarns of the new yarn-feeding bobbins are knotted together with ends of yarns remaining on the creel respectively by human hand. Then, a wind-up device is operated to wind up the yarns on a beam. As for knotting, there are various kinds of knotting devices in which yarns are knotted successively automatically not by human hand but by knotters, or the like. These knotting devices are already known.

[0004] However, when the aforementioned automatically knotting device is used, whether knotting is perfect depends on the holding state of yarns. Hence, it is difficult to knot yarns perfectly, so that knotting failure occurs. Moreover, even in the case where yarns seem to be knotted perfectly, the yarns are often unknotted at

the time of pulling-out of the yarns by the operation thereafter if the knotting is imperfect. More in detail, an initial end of yarn of a new yarn-feeding bobbin still remains near the new bobbin whereas an end of yarn remaining on the creel contracts zigzag and then hangs downward because the tension of the yarn is released. Particularly in the case of twisted yarn, etc., the yarn comes into contact with adjacent yarns or yarns passing through the lower stage and gets entangled with these yarns. Even in the case where the yarn does not get entangled, the yarn comes out of several intermediate guides (eyelets) and tensioning mechanisms (disk tensioners) provided along the yarn path on the downstream side because of the operation of the wind-up beam. Therefore, a great deal of labor and time is required for repairing these. Particularly to make the yarn pass through the tensioning devices and intermediate guides located in high positions, an operator must make the repairing work while getting on and off a stepladder, or the like, whenever moving the stepladder to each of the positions of the devices and guides. This was a hard job.

[0005] Generally, a yarn-break detecting device is attached to an outlet of the creel. Therefore, it is conceived that the yarn-break detecting device is made to operate. In the operation of the wind-up beam after the knotting, however, the tension of yarn is low compared with the ordinary state so that malfunction occurs easily because low-speed driving is sometime performed. Even in the case where the yarn-break detecting device is made to operate, break of yarn cannot be detected until the end of yarn comes out of the tensioning devices. This was not useful at all for avoiding the complex repairing work for knotting failure.

SUMMARY OF THE INVENTION

[0006] The present invention is devised in consideration of the aforementioned problems, and an object of the present invention is to provide an apparatus for detecting a knotting state in a creel, in which whether knotting is perfect is detected securely by a simple structure when winding is started to simultaneously pull out yarns after a leading end of yarn of a newly placed yarn-feeding bobbin is knotted together with an end of yarn remaining in an old yarn-feeding bobbin.

[0007] According to the present invention, there is provided an apparatus for detecting the knotting state in a creel, comprising: a knotting device for knotting an end of remained yarn of a first bobbin to be exchanged with an end of yarn led out of a second bobbin to be newly replaced; a first holder for holding the end of the yarn of the first bobbin; a second holder for holding the end of the yarn led out of the second bobbin; a tension-applying means for applying a predetermined amount of tension to the yarns by bringing a tension-applying member into contact with the knotted yarns held by the first and second holders respectively; and a detection

means for detecting a state of tension applied to the yarns by the tension-applying means. Preferably, in the above apparatus, the tension-applying means may be configured to apply the tension to the yarns by applying the tension-applying member's own weight to the yarns. More preferably, in the above yarn knotting detecting apparatus, the tension-applying means and the detection means may be provided for each yarn-feeding bobbin.

[0008] Further preferably, in the above yarn knotting detecting apparatus, the tension-applying means may be configured so as to include a tension-applying member having an engagement portion capable of being engaged with the knotted yarns, and a rod slidably supported by the creel and driven to move back and forth in a direction of the length of said rod through a drive means, the tension-applying member being formed so as to be movably engaged with the rod and being driven to be displaced in a yarn-engagement direction by the drive means so that force acting on the rod is reduced by the engagement of the engagement portion with the yarns, whereby tension up to the predetermined amount of tension is applied to the yarns so that the tension-applying member is moved relatively to the driven rod.

[0009] More preferably, in the above yarn knotting detecting apparatus, the detection means may be configured to detect the tension-applying state by detecting the relative movement and position of the tension-applying member due to mechanical movement. More preferably, indicators for indicating results of detection of the tension-applying state are provided near the yarn-feeding bobbins respectively. More preferably, in the above yarn knotting detecting apparatus, the knotting detecting device is configured to be operated before yarns are pulled out simultaneously after the operation of the knotting device.

[0010] In the detecting device for detecting the knotting state in a creel according to the present invention, a tension-applying member is made to move toward yarns held by two holders respectively and abut on the yarns. If knotting of the yarns is perfect on this occasion, the knotted yarns endure the urging force of the tension-applying member. As a result, the tension-applying member stays in the position while donating tension to the yarns. However, if there is knotting failure or if knotting is imperfect, the yarns may be unknotted by the urging force of the tension-applying member. As a result, there is no yarn as a subject of donation of tension, so that tension is not applied. Hence, the tension-applying member does not move relatively to the drive means but further moves from the predetermined position. That is, the state of tension applied to the yarns, that is, whether knotting of the yarns is perfect can be checked when the relative movement, or the like, of the tension-applying member is detected by the detection means in accordance with the donation of tension.

[0011] If the tension-applying member's own weight is made to act for the aforementioned donation of ten-

sion, the applied tension can be set appropriately by the change of the weight of the member. Further, if configuration is made so that the tension-applying member moves relative to the driven rod as described above, there is no risk that a larger amount of tension than the set tension is applied to the knotted yarns held by the holders respectively. Further, if knotting detection results obtained by the detection means are indicated, the repairing work can be performed efficiently. Further, if the yarn knotting detecting apparatus is operated at least before knotted yarns are pulled out simultaneously, knotting failure can be found easily. Moreover, the yarn ends are located near the holders respectively. Hence, knotting failure can be repaired easily without any great deal of labor and time required for the repair as in the background art, that is, for the repair to find the ends of the wound yarns and knot the ends of the yarns.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1A is a front view of an apparatus for detecting a knotting state in a creel according to the first embodiment of the present invention;

Fig. 1B is a side sectional view of Fig. 1A;

Fig. 2 is a front view showing the operating state of the apparatus for detecting the knotting state in the creel according to the first embodiment;

Fig. 3 is a plane view showing a creel disposed with the apparatus for detecting the knotting state according to the first embodiment;

Fig. 4 is a front view of the creel disposed in the apparatus for detecting the knotting state according to the first embodiment;

Fig. 5 is a plane view of a yarn-feeding bobbin and the apparatus for detecting the knotting state according to the first embodiment;

Fig. 6 is a perspective view of an apparatus for detecting a knotting state in a creel according to the second embodiment of the present invention; and

Fig. 7 is a front view of explaining an embodiment as to an indicating method of a knotting state detecting result according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] A description will be given below of a first embodiment of the present invention with reference to Figs. 1 - 5. Figs. 3 and 4 show a creel 13 and a wind-up unit for pulling out yarns simultaneously from the creel 13 and winding up the yarns onto a wind-up beam 48. The creel 13 has a plurality of racks 17. The racks 17 are arranged in a direction of the length of the creel 13 so that a plurality of lines of yarn-feeding bobbins 12 are placed on the racks 17. The racks 17 are provided with holders 19 capable of holding the yarn-feeding bobbins

12. The holders 19 can rotate by 180° through vertically extending axes. Moreover, the holders 19 are erected at approximately regular intervals on respective front and rear surfaces of frames 14 that constitute the racks 17. In this manner, a so-called semi-magazine creel is configured so as to hold the yarn-feeding bobbins on front and rear surfaces of the creel.

[0014] Respective yarns from the yarn-feeding bobbins 12 are collected like a sheet via guides (eyelets), disk tensioners 40, etc. disposed in the creel 13. The disk tensioners 40 give tension to the yarns. Then, the yarns are wound up onto the wind-up beam 48 via guide rolls 44, 45 and 46 (of wind-up unit). Incidentally, knotters 42 as yarn knotting units for knotting yarns of the yarn-feeding bobbins 12 and creel-side remaining yarns together are disposed on a carriage which can self-move along a direction of the length of the creel 13. The knotters 42 are provided correspondingly to respective vertical columns of yarn-feeding bobbins.

[0015] Fig. 5 shows the periphery of a yarn-feeding bobbin in the creel 13 and shows the position of an apparatus 10 for detecting a knotting state (yarn knotting detecting apparatus), which is a main portion of the present invention. A nipping member 38 is provided at an end of the holder 19 provided in a frame 17. The nipping member 38 is formed to protrude from an end portion of the yarn-feeding bobbin so as to hold a leading end of yarn from the yarn-feeding bobbin 12 at the time of attachment of the yarn-feeding bobbin. For example, the nipping member 38 is constituted by two plate-like members so as to nip yarn. Contact pressure, that is, holding force of the nipping member 38 is set so as to be released easily in accordance with increase of tension due to pulling-out of yarn when a wind-up unit will be operated after that.

[0016] A disk tensioner 40 is disposed in a position opposite to the yarn-feeding bobbin 12. The disk tensioner 40 serves as a tensioning unit for adjusting pulling-out of yarn so that tension of a yarn on the downstream side of the disk tensioner 40 is set to be a predetermined value. The disk tensioner 40 holds yarn connected to a wind-up beam on the downstream side of the disk tensioner 40. That is, the nipping member 38 is equivalent to a first holder for holding a leading end of yarn from a new yarn-feeding bobbin and the disk tensioner 40 is equivalent to a second holder for holding an end of yarn remaining on the creel. As shown in Fig. 5, the knotter 42 which is a yarn knotting means can enter in between the first and second holders from a side as well as the yarn knotting detecting apparatus 10 according to the present invention is disposed between the first and second holders.

[0017] The yarn knotting detecting apparatus 10 stands by in a predetermined upper position so as not to disturb knotting. Each of the holders is made to hold yarn so that a length required for knotting is reserved from an end of the yarn. The yarns held by the holders respectively are knotted together by entrance of the

knotter 42 and the operation thereof. Although the operation of the knotter 42 will be not described in detail, the respective yarns from the holders are knotted together by a known knotting device such as a mechanical knotter, an air splicer, or the like, while being held in the state that the yarns are made to intersect one another. After knotting, the yarns are still held by the first and second holders continuously.

[0018] Figs. 1 and 2 show the yarn knotting detecting apparatus 10 viewed from the front side of the yarn-feeding bobbin 12. The yarn knotting detecting apparatus 10 has: a tension-applying lever 18 which is a tension-applying member; a combination of a rod 34 and a drive actuator 15 as a drive means for displacing the tension-applying lever 18; and a proximity sensor 32 which is a detection means for detecting the tension-applying lever 18. In a frame 14 extending vertically so as to correspond to the yarn-feeding bobbins on the creel 13, the tension-applying lever 18 shaped like a slender rod is located so as to intersect the yarn 16 held by the nipping member 38 and the disk tensioner 40. The tension-applying lever 18 is formed with an attachment portion 20 with a broad width on a base end portion thereof. Moreover, the base end portion of the tension-applying lever 18 is integrated with a pipe-like bearing portion 22 which extends in a direction perpendicular to the base end portion. The bearing portion 22 is further integrated with a detection piece 24 extending radially in a direction opposite to the tension-applying lever 18 and with an engagement piece 26 located near the detection piece 24 and extending radially and axially.

[0019] The engagement piece 26 is provided in a position rotated counterclockwise by a predetermined angle around the axis of the bearing portion 22 relative to the detection piece 24 as shown in Fig. 1A. The predetermined angle is set appropriately in accordance with the knotting detection operation as will be described later. Further, a free end of the engagement piece 26 is formed so as to be far by a predetermined distance from the bearing portion 22 and extend in parallel with the axial direction of the bearing portion 22. A shaft 28 is inserted into the bearing portion 22 and erected in a predetermined position of the frame 14 to thereby support the aforementioned tension-applying lever 18 pivotally.

[0020] In the frame 14, the proximity sensor 32 is provided on a bent piece 30, which is located above the shaft 28 and extends in parallel with the shaft 28. A gap between the detection piece 24 and a detecting portion of the proximity sensor 32 opposite to the detection piece 24 is preliminarily set to be a value required for detecting the detection piece 24. Further, the rod 34 extending vertically is provided near a side of the frame 14. As shown in Fig. 2, the rod 34 is connected to the drive actuator 15 such as an air cylinder which is a drive means. The rod 34 is held so as to be vertically movable along the frame 14. The rod 34 is provided with rising

pieces 36 which extend horizontally corresponding to the engagement pieces 26 of the tension-applying levers 18 and which have protrusions capable of hooking the engagement pieces 26 respectively. With the vertical movement of the rod 34, the engagement pieces 26 are securely engaged with the rising pieces 36 respectively, so that the tension-applying levers 18 can be rotated.

[0021] A series of operations from the exchange of the yarn-feeding bobbins to the start of the yarn knotting detecting apparatuses 10 will be described below. First, when the existing old yarn-feeding bobbin 12 having yarn running short is to be exchanged to a new yarn-feeding bobbin 12, yarn 16 of the old yarn-feeding bobbin 12 is once cut on the upstream side of the disk tensioner 40. On this occasion, an end of the yarn 16 wound on the old yarn-feeding bobbin 12 is held by the disk tensioner 40 in the condition that a portion of yarn having a length required for knotting after that is hung in front of the disk tensioner 40. While the frame 17 in which the old yarn-feeding bobbin 12 is held is rotated by 180°, the old yarn-feeding bobbin 12 is exchanged to a new yarn-feeding bobbin 12. On this occasion, a leading end of yarn of the new yarn-feeding bobbin 12 is held by the nipping member 38. Moreover, the new yarn-feeding bobbin 12 is provided in the condition that a portion of yarn having a length required for knotting after that is hung in front of the nipping member 38. On the other hand, in the yarn knotting detecting apparatus 10, the rod 34 is moved down so that the rising piece 36 of the rod 34 is located in a position applied by the two-dot chain line in Fig. 1A. And, the engagement piece 26 is pressed down so that the tension-applying lever 18 is located in a standby position denoted by A in Fig. 1A. Incidentally, the standby position A is set to be higher than the position of yarn 16 of the yarn-feeding bobbin 12 so that knotting by the knotter 42 is not disturbed.

[0022] The end of old yarn held by the disk tensioner 40 and the end of yarn held by the nipping member 38 are automatically knotted by the knotter 42. As a result, the knot of yarn is located between the nipping member 38 and the disk tensioner 40. Moreover, the knotted yarns are held by the nipping members 38 and the disk tensioner 40 respectively.

[0023] Incidentally, another method may be conceived as the method for knotting an end of yarn of the yarn-feeding bobbin and an end of yarn remaining on the creel. Although the aforementioned example has shown the case where yarns hung from the nipping member 38 and the disk tensioner 40 respectively are knotted together by the knotter 42, there may be also used a method in which the knotter 42 sucks a leading end of yarn out of the yarn-feeding bobbin 12 directly and knots it together with yarn held by the disk tensioner 40. In this case, the knotted yarns are set by the knotter 42 or by a separately configured member so that the knot of yarn is located between the nipping member 38 and the disk tensioner 40. In this case, moreover, the

knotted yarns are set to be held by the nipping member 38 which is the first holder. In this manner, after the leading end of yarn of the newly placed yarn-feeding bobbin and the remaining end of yarn of the old yarn-feeding bobbin are knotted together by the knotter, the leading end of yarn of the new yarn-feeding bobbin 12 and the remaining end of yarn of the old yarn-feeding bobbin can be held by the nipping member 38 and the disk tensioner 40 as the first and second holders respectively. Then, whether the yarns are knotted securely is confirmed by the yarn knotting detecting apparatus 10.

[0024] For confirmation of knotting, the yarn knotting detecting apparatus 10 operates devices such as a drive actuator, a sensor, etc. on the basis of a knotting completion signal from the knotter or a signal generated by the operation of a push button, or the like, through a controller not shown. Hence, a series of knotting detection operations that applies tension to yarn is started. The rod 34 is moved down by the drive actuator 15 in advance so that the rising piece 36 stands by in a position denoted by the two-dot chain line in Fig. 1A whereas the tension-applying lever 18 is made to stand by in a position applied by A in Fig. 1A. Further, when the rod 34 is driven to move up by the drive actuator 15, the tension-applying lever 18 is rotated clockwise around the shaft 28 by its own weight, moves down toward yarn 16 held between the nipping member 38 and the disk tensioner 40, and finally comes into contact with the yarn 16. In this case, force generated in the yarn 16 by the own weight of the tension-applying lever 18 is previously set to be weaker than the holding force of the nipping member 38 and the disk tensioner 40 and to be suitable for detection of knotting failure. If the knot 16a of yarn by the knotter 42 is perfect, the yarn 16 endures the weight of the tension-applying lever 18. Hence, the tension-applying lever 18 is stopped by the yarn 16, so that the engagement of the engagement piece 26 to the rising piece 36 is released. Hence, the tension-applying lever 18 stays in a position denoted by B in Fig. 1A.

[0025] If knotting cannot be performed or if knotting is imperfect, the yarn 16 is, however, unknotted by the weight of the tension-applying lever 18. Hence, the tension-applying lever 18 falls down to a position denoted by C in Fig. 1A while the engagement piece 26 and the rising piece 36 are kept engaged with each other. In this manner, the rod 34 is driven to bring the tension-applying lever 18 as a tension-applying member into contact with the yarn 16 knotted between the two holders so that a predetermined amount of tension is applied to the yarn 16. In other words, the drive actuator 15 as a drive means drives the tension-applying lever 18 as a tension-applying member to move in a yarn-engagement direction so that relative movement of the rod 34 and the tension-applying member is generated by the tension-applying state while a predetermined amount of tension is applied to the yarn by the engagement of the tension-

applying lever 18 with the yarn knotted between the two holders.

[0026] When the tension-applying lever 18 rotates to the position C, the detection piece 24 on a side opposite to the tension-applying lever 18 approaches the proximity sensor 32 provided in the frame 14. Hence, the detection piece 24 is detected by the proximity sensor 32. The proximity sensor 32 outputs a knotting failure detection signal, so that the knotting failure is indicated. Upon reception of the knotting failure detection signal, the wind-up device is prohibited from operating. Then, the unkotted yarns are knotted again by human hand or by the knoter 42 so that repair-missing trouble due to knotting failure is prevented from occurring. In this manner, the proximity sensor as a detection means can detect the tension-applying state by detecting the relative movement of the tension-applying member constituting the tension-applying means.

[0027] With respect to this operation, detection for yarn-feeding bobbins disposed vertically may be made simultaneously by yarn knotting detecting apparatuses 10 provided for every yarn-feeding bobbin 12, for example, as shown in Fig. 2. In Fig. 2, tension-applying levers 18 in most of the yarn knotting detecting apparatuses 10 stay in operating positions B expressing the fact that knotting is perfect. However, when knotting is imperfect as represented by the yarn-feeding bobbin 12a, the tension-applying lever 18a of a corresponding yarn knotting detecting apparatus 10 falls down to an operating position C expressing the fact that knotting is imperfect. Incidentally, detection by the yarn knotting detecting apparatuses 10 is preferably performed just after a knotting process by knotters 42 is completed for each row of yarn-feeding bobbins 12. The point of knotting failure can be known whenever the knotters 42 move to the next row. As a result, the knotting operation of the knotters 42 can be changed so that a knotting process can be performed again only for the point of knotting failure.

[0028] The yarn knotting detecting apparatus 10 according to this embodiment includes a tension-applying means for driving a tension-applying member to come into contact with yarn knotted between two holders to thereby apply a predetermined amount of tension to the yarn, and a detection means for detecting a state of tension applied to the yarn by the tension-applying means. The knot hardly judged from the eye as to whether the knot is perfect can be brought into contact with the tension-applying lever 18 so that the position of the tension-applying lever is detected while a predetermined amount of tension is applied to the knot. Hence, the tension-applying state, that is, whether knotting is perfect or not, can be judged easily and securely. Moreover, imperfect knotting can be detected securely because the imperfectly knotted yarns are unkotted or broken when an appropriate amount of tension is applied to the knot. Hence, there can be prevented operation loss which is such that a great deal of labor is required for knotting an end of yarn of a yarn-feeding

bobbin and an end of yarn of a new yarn-feeding bobbin 12 again because the end of yarn reaches the downstream side because of the starting of an operation of the wind-up beam 48 caused by missing of knotting failure as in the background art.

[0029] Further, because the tension applied to the yarn 16 is operated by the own weight of the tension-applying lever 18, the tension can be set easily by adjustment of the weight of the tension-applying lever 18. Further, because a plurality of tension-applying levers 18 are driven by one rod 34, the number of drive actuators can be reduced. Hence, configuration for applying tension can be simplified. Further, because ends of yarns in knotting failure are still held by the nipping member 38 and the disk tensioner 40 respectively, an operator can make a repair easily without any labor required for searching for the ends of the yarns. Moreover, because whether the knotting is perfect or not can be judged easily, automatic knotting by knotters can be employed. Further, as described above, the drive actuator 15 as a drive means drives the tension-applying lever 18 as a tension-applying member to move in a yarn-engagement direction so that relative movement of the rod 34 and the tension-applying member is generated by the tension-applying state while a predetermined amount of tension is applied to the yarn by the engagement of the tension-applying lever 18 with the yarn knotted between the two holders. Hence, simplified configuration is obtained. Moreover, the applied tension is not higher than the preset tension, so that breaking of yarn caused by expressive tension, or the like, never occurs. For these reasons, the old yarn-feeding bobbin 12 can be exchanged to a new yarn-feeding bobbin 12 efficiently. As described above, after the detection of knotting, the drive actuator 15 drives again the tension-applying levers 18 to restore to the original positions A so that the tension-applying levers 18 do not disturb the operation of the wind-up devices, that is, simultaneous pulling-out of yarns.

[0030] Next, a description will be given below of a second embodiment of the present invention with reference to Fig. 6. Here, parts the same as those in the aforementioned embodiment are referenced correspondingly, and the description thereof will be omitted. A yarn knotting detecting apparatus 50 in this embodiment is shown as an example in which a tension-applying member 61 and a detection means are disposed on the rod 34 extending vertically.

[0031] The rod 34 driven vertically is provided with an arm portion 52 extending horizontally correspondingly to the yarn-feeding bobbin. An insertion portion 68 which is a hole for inserting and holding the tension-applying member 61 is formed in the arm portion 52. Base end portions 54 and 56 for arranging photoelectric sensors for outputting signals in accordance with the movement of the tension-applying member 61 are provided in positions opposite to each other with respect to the insertion hole 68. The insertion portion 68 and the

base end portions 54 and 56 are integrated with the rod 34. Incidentally, a light transmitter 58 and a light receiver 60 which are constituted by photoelectric sensors as detection means are provided on the base end portions 54 and 56 so as to be opposite to each other respectively. The light transmitter 58 and the light receiver 60 are disposed to form an optical axis.

[0032] The tension-applying member 61 has a light shielding member 62, an engagement portion 66 opened downward like a reversed V figure, and a support portion 64 for connecting the two. The engagement portion 66 and the support portion 64 are integrated with each other. The light shielding member 62 and the support portion 64 are detachably attached to each other by a connecting method such as screwing. Hence, the tension-applying member 61 can be inserted into the insertion portion 68 of the arm portion. Therefore, after the support portion 64 is inserted into the insertion portion 68 of the arm portion 52, an end portion of the support portion 64 is attached to the light shielding member 62. The light shielding member 62 shaped like a cylinder, etc. is disposed between the light transmitter 58 and the light receiver 60. Yarn 16 pulled out of the yarn-feeding bobbin 12 is disposed below the center of the engagement portion 66 so as to cross the engagement portion 66. Incidentally, the inner diameter of the insertion portion 68 is formed to be larger than the outer diameter of the support portion 64 so that the tension-applying member can move vertically with engagement of the tension-applying member with the yarn. In practice, a plurality of light shielding members 62 different in weight are prepared so that tension to be applied can be set freely by combination of such different light shielding members 62 in accordance with the kind of yarn.

[0033] The operation of the yarn knotting detecting apparatus 50 will be described below. First, for the operation of the knotter 42, the rod 34 is driven upward so that the engagement portion 66 is set to be located in an upper standby position so as not to disturb the operation of the knotter 42. Incidentally, in this driving, the bottom surface of the light shielding member 62 abuts on the arm portion 52, so that the rod 34 and the tension-applying member 61 do not move relatively but move up integrally. Then, yarns held by two holders not shown are knotted by the operation of the knotter 42.

[0034] To confirm the knotting state of the yarn 16 after the operation of the knotter 42, the rod 34 is driven downward. The rod 34 is further driven to a predetermined position decided in consideration of the movable range of the tension-applying member 61, that is, the movable length of the support portion 64 so that the engagement portion 66 goes beyond the predicted yarn contact position. Then, the rod 34 is stopped at the predetermined position. If the knotting state by the knotter 42 is perfect in this case, the yarn 16 abuts on the engagement portion 66 in accordance with the down movement of the rod 34 and endures the weight of the tension-applying member 61. Hence, the tension-applying

member 61 stays still. The tension-applying member 61 apparently relatively moves up through the insertion portion 68 of the rod 34 so as to be located between the light transmitter 58 and the light receiver 60 to block off light emitted from the light transmitter 58. As a result, the light receiver 60 can detect the fact that the knotting state 16 is completed securely.

[0035] However, when the knotting state 16 cannot be performed or when knotting is imperfect, the yarn 16 is unknotted by the weight of the tension-applying member 61. Hence, the light shielding member 62 moves down together with the arm portion 52 while being supported by the arm portion 52. On this occasion, the light shielding member 62 does not move relative to the arm portion 52 and does not block off the optical axis between the light transmitter 58 and the light receiver 60. Hence, the light receiver 60 can still receive light from the light transmitter 58 to detect the fact that knotting is imperfect. Further, the light receiver 60 indicates information of knotting failure on the basis of the knotting detection signal. Upon reception of the information, the wind-up device is prohibited from operating. The yarn knotting detecting apparatus 50 according to this embodiment has the same effect as that according to the first embodiment. That is, the knotting state 16 hardly judged from the eye as to whether knotting is perfect or not, can be judged securely.

[0036] Next, a description will be given below of an embodiment for indicating the knotting detection result detected by the present invention will be described below with reference to Fig. 7. Here, parts the same as those in the aforementioned embodiments are referenced correspondingly, and the description thereof will be omitted. In each frame 14 extending vertically, indicators 70 for indicating the knotting detection results of the yarn knotting detecting apparatuses are provided near the yarn-feeding bobbins 12 respectively. Each of the indicators 70 is provided with a knotting failure indicating lamp 72 and a reset button 74 for switching off the knotting failure indicating lamp 72.

[0037] The operation of the indicator will be described below. First, when knotting failure is detected by the yarn-knotting detecting apparatus after the operation of the knotter 42, a corresponding knotting failure indicating lamp 72 near the yarn-feeding bobbin 12 in knotting failure turns on. This operation is performed as follows. A knotting failure signal is stored in a flip-flop (not shown), so that an indicating lamp corresponding to the yarn-feeding bobbin 12 in knotting failure is turned on by the output of the flip-flop. Then, knotting is tried again, for example, by human hand. After knotting becomes perfect, the reset button 74 is pushed to reset the flip-flop to thereby turn off the knotting failure indicating lamp 72. Then, knotting is checked again by the yarn knotting detecting apparatus or pulling-out of yarn 16 is restarted.

[0038] According to thus structured yarn knotting detecting apparatus with the indicators 70, conveniently,

it is possible to visually detect the yarn-feeding bobbin 12 which fails to knot yarns. Further, repairs can be performed in an efficient sequence in consideration of the position of occurrence of knotting failure. Moreover, when an operation is made to turn off the indication of the repaired yarn-feeding bobbin, missing of repair can be eliminated securely. Particularly when the indicators 70 are provided correspondingly to the yarn-feeding bobbins 12, the operator can perform repairs in an efficient sequence in consideration of the position of occurrence of knotting failure.

[0039] Incidentally, the apparatus for detecting the knotting state in a creel according to the present invention is not limited to the aforementioned embodiments. Any shape may be used as the shape of the tension-applying member so long as the tension-applying member can apply a predetermined amount of tension to yarn. Hence, there may be also used a method in which a flexible tension-applying lever such as a leaf spring is pressed against yarn so that a part of the deformed leaf spring is detected by a proximity sensor. In this case, tension corresponding to the quantity of deflection of the tension-applying lever (the drive quantity of the rod) is applied, so that the detecting device judges the tension-applying state in such a predetermined deflection state. There may be further used a method in which a retaining member held by a coiled spring is pressed against yarn so that the retaining member approached by the deformed coiled spring is detected by a proximity sensor.

[0040] Further, a pair of yarn knotting detecting apparatuses or a plurality of yarn knotting detecting apparatuses may be provided on a self-propelled robot attached to the creel so that knotting states are detected by the yarn knotting detecting apparatuses respectively while the self-propelled robot is successively moved to a yarn-feeding bobbin whenever the knotting state of the yarn-feeding bobbin is completed. Further, either one of the tension-applying means and the detection means may be provided on the creel so as to correspond to each yarn-feeding bobbin whereas one or a plurality of means as the other one of the tension-applying means and the detection means may be provided on a self-propelled robot attached to the creel. In this case, knotting states are detected while the self-propelled robot is moved successively. Further, the detecting apparatus may be of the type of detecting the presence/absence of yarn.

[0041] The detection means in the detecting apparatus may be an electric means or a mechanical means. A contact type sensor such as a distortion sensor, a limit switch, or the like, or a non-contact type sensor such as a proximity switch, a photoelectric sensor, or the like, can be conceived as the electric detection means. The detection means may be attached to any place such as the rod, the frame of the creel, etc.

[0042] Batch indication (graphic display) may be made by one indicator or indication may be made by

indicators provided near the yarn-feeding bobbins respectively, regardless of the control method after detection and the indication method of the indication means. The indication method of the indication means may be of the type of mechanical indication such as raising of an indication flag or of the type of electric indication such as lighting of an indicating lamp. Further, configuration from the detection of the tension-applying state by the detection means to the indication by the indicator is not limited. The method of transmission of the detection signal may be of a wire type, of a wireless type or of an optical type.

[0043] Tension applied to yarn can be changed easily by adjustment of the weight of the tension-applying member. If configuration is made so that the tension-applying member's own weight applied to yarn is reduced after knotting failure is detected in the condition that the tension-applying member is engaged with the yarn, a larger amount of tension than the tension-applying member's own weight is not applied to the yarn. Hence, there can be prevented an accident which is such that the yarn is cut because an excessive amount of tension is applied to the yarn by mistake, for example, due to driving error, or the like.

[0044] The rod-drive actuator may be provided individually in each rod or collectively for every several rods. Further, force of driving one rod may be transmitted to the tension-applying member through a movement direction changing member provided separately. The direction of action of the tension-applying member on yarn may be vertical or horizontal.

[0045] The apparatus for detecting the knotting state in a creel according to the present invention comprises a tension-applying means for bringing a tension-applying member into contact with knotted yarns held by two holders respectively to thereby apply a predetermined amount of tension to the yarns, and a detection means for detecting a state of tension applied to the yarns by the tension-applying means. Hence, the state of tension applied to the knotted yarns can be detected. If knotting is perfect, the knotted yarns endure the urging force of the tension-applying member and get in a tension-applied state. On the contrary, if knotting fails or the knot is imperfect, tension is not applied to the yarns because the yarns are unknotted by the urging force of the tension-applying member or there is no yarn as a subject of donating of tension. Hence, when the tension-applying state is detected in the condition that driving is performed to apply a desired amount of tension to the yarns while the tension-applying member is brought into contact with the yarns, knotting hardly judged by the eye as to whether knotting is perfect can be detected by simple configuration and securely.

[0046] If the tension-applying member's own weight is made to act for donating tension, the applied tension can be set appropriately by the change of the weight of the member. Further, if configured is made so that the tension-applying member moves relatively to the driven

rod as described above, there is no risk that a larger amount of tension than the set tension is applied to the knotted yarns held by the holders respectively. Further, if knotting detection results of the detection means are indicated, repairs can be made efficiently. Further, if the yarn knotting detecting apparatus is operated before knotted yarns are pulled out simultaneously by the operation of the wind-up device, knotting failure can be found easily. Moreover, ends of the yarns are located near the holders respectively. Hence, knotting failure can be repaired easily without any great deal of labor and time for repair as in the background art, that is, repair to find the ends of the already wound yarns and knot the yarns.

Claims

1. An apparatus (10, 50) for detecting a knotting state in a creel (13), comprising:
 - a knotting device (42) for knotting an end of remained yarn (16) of a first bobbin to be exchanged (12) with an end of yarn (16) led out of a second bobbin to be newly replaced (12);
 - a first holder (40) for holding the end of the yarn of said first bobbin (12);
 - a second holder (38) for holding the end of the yarn led out of said second bobbin (12);
 - a tension-applying means for applying a predetermined amount of tension to the yarns by bringing a tension-applying member into contact with the knotted yarns (16) held by said first and second holders (38, 40) respectively; and
 - a detection means (24, 32, 58, 60, 62) for detecting a state of tension applied to the yarns by said tension-applying means.
2. The apparatus (10, 50) according to claim 1, wherein said tension-applying means applies the tension to the yarns (16) by applying said tension-applying member's own weight to the knotted yarns.
3. The apparatus (10, 50) according to claim 2, wherein said tension-applying means includes:
 - a rod (34) slidably supported to the creel (13), said rod (34) moving in a longitudinal direction of said rod (34) through a drive means (15); and
 - said tension-applying member (18, 64) having an engagement portion (66) capable of being engaged with the knotted yarns (16), said tension-applying member (18, 64) being formed so as to be engagable with said rod (34), wherein said tension-applying member (18, 64) is driven to be displaced in a yarn-engagement direction by said drive means while engaging
- with said rod (34), and
- said tension-applying member (18, 64) is moved relative to said driven rod (34) by disengaging with said rod (34), when said tension-applying member (18, 64) is engaged with the knotted yarn (16).
4. The apparatus (10, 50) according to claim 3, wherein when said tension-applying member (18, 64) is engaged with the knotted yarn (16), said tension-applying member (18, 64) reduces the force acting on said rod (34), and the predetermined amount of tension is applied to the knotted yarn (16), so that said tension-applying member (18, 64) is moved relative to said rod (34).
5. The apparatus (10, 50) according to one of the preceding claims, wherein said tension-applying means and said detection means (24, 32, 58, 60, 62) are respectively provided for each set of said first and second bobbins (12).
6. The apparatus (10, 50) according to one of the preceding claims, wherein said detection means (24, 32, 58, 60, 62) detects the tension-applying state by detecting said relative movement of said tension-applying member (18, 64).
7. The apparatus (10, 50) according to claim 6, wherein said detection means comprises: a detection piece (24) attached to said tension-applying member (18) and a sensor (32) attached to said rod (34) for detecting the position of said detection piece (24).
8. The apparatus (10, 50) according to claim 6, wherein said detection means comprises: a light shielding member (62) attached to said tension-applying member (18), and a light transmitter (58) and the light receiver (60) attached to said rod (34) to interpose said light shielding member (62).
9. The apparatus (10, 50) according to one of the preceding claims, wherein said knotting detecting apparatus (10, 50) is operated before yarns (16) are pulled out simultaneously after the operation of said knotting device (42).

FIG. 1A

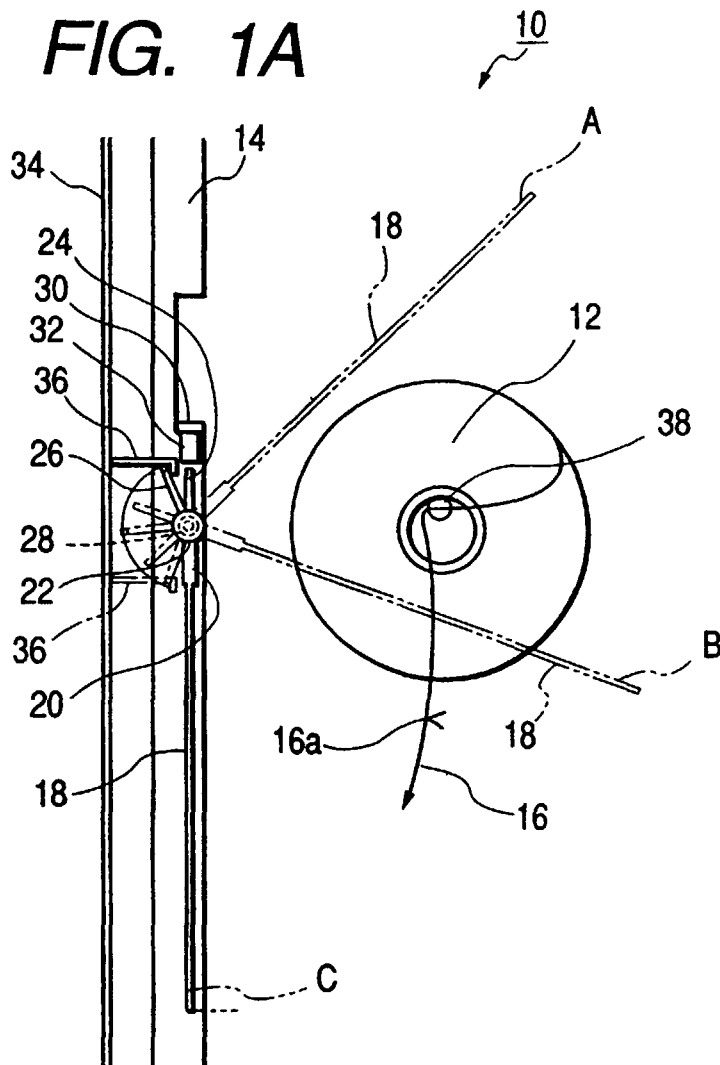


FIG. 1B

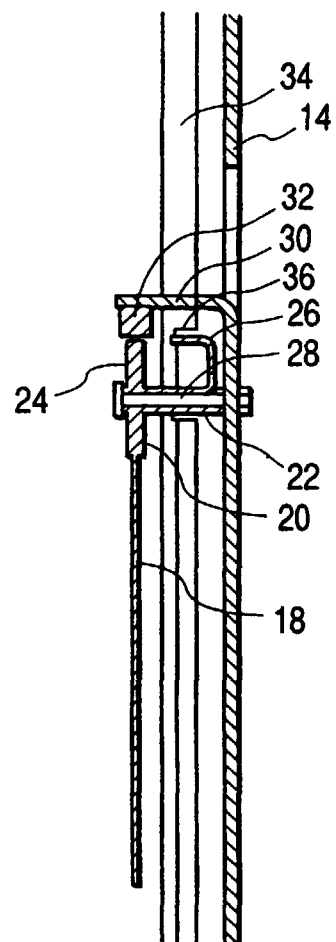


FIG. 2

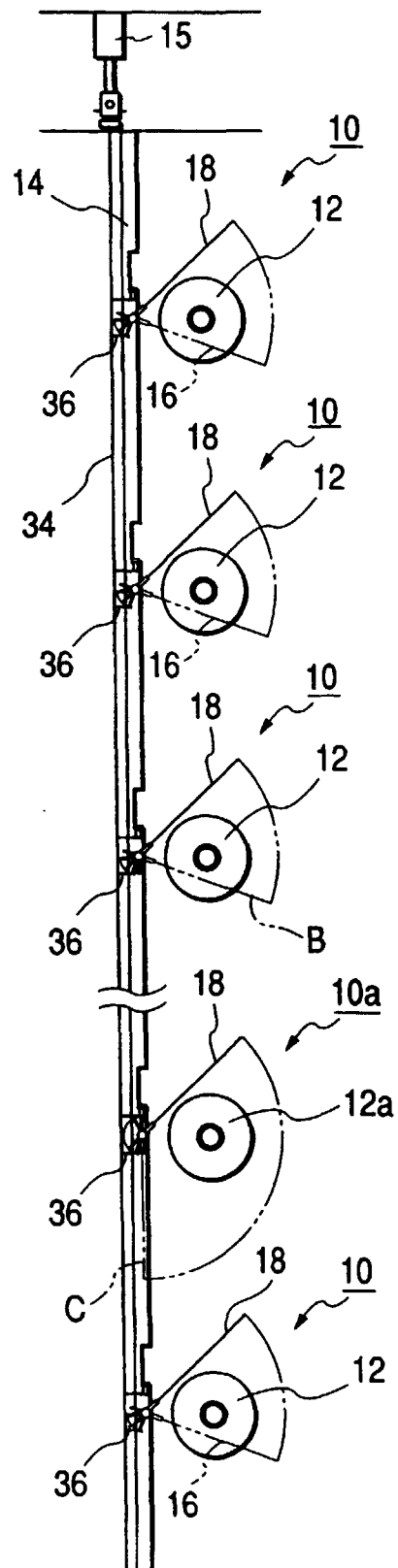


FIG. 3

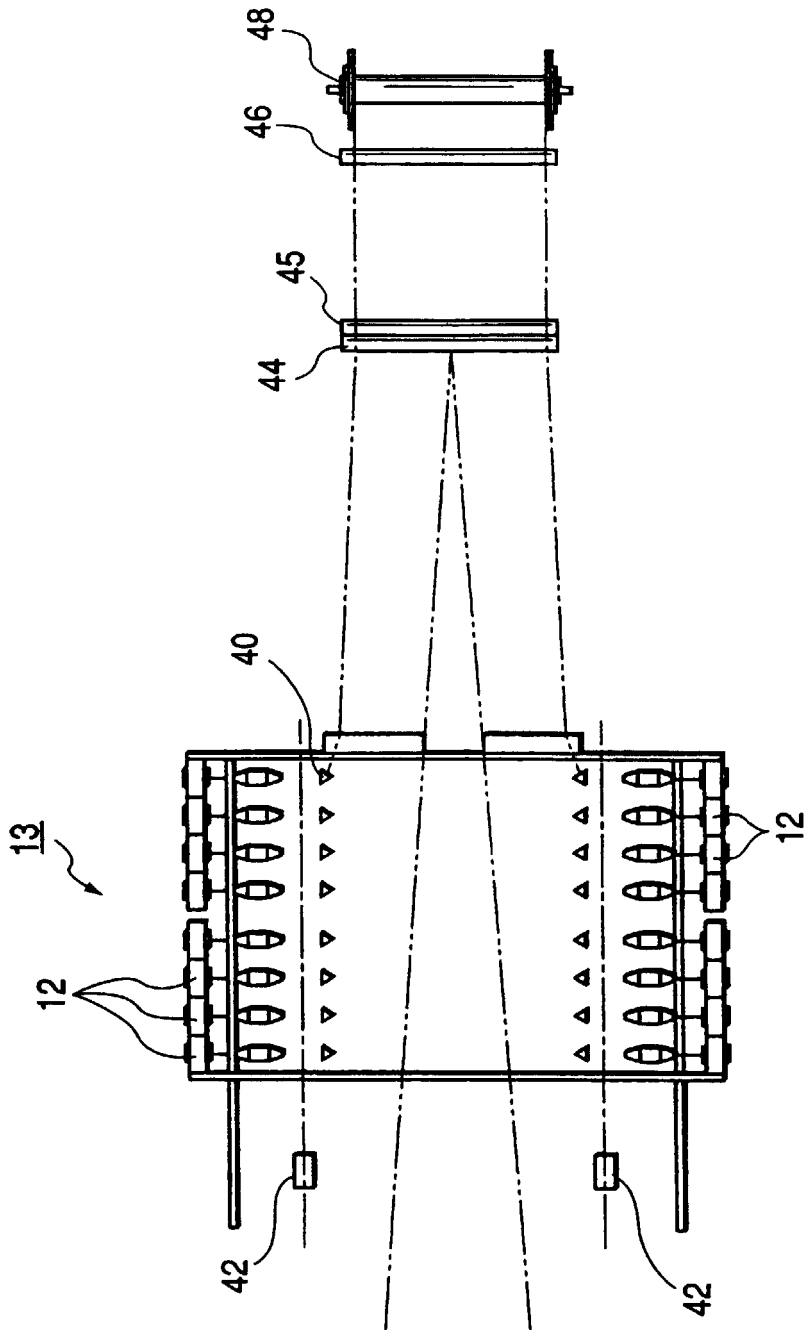


FIG. 4

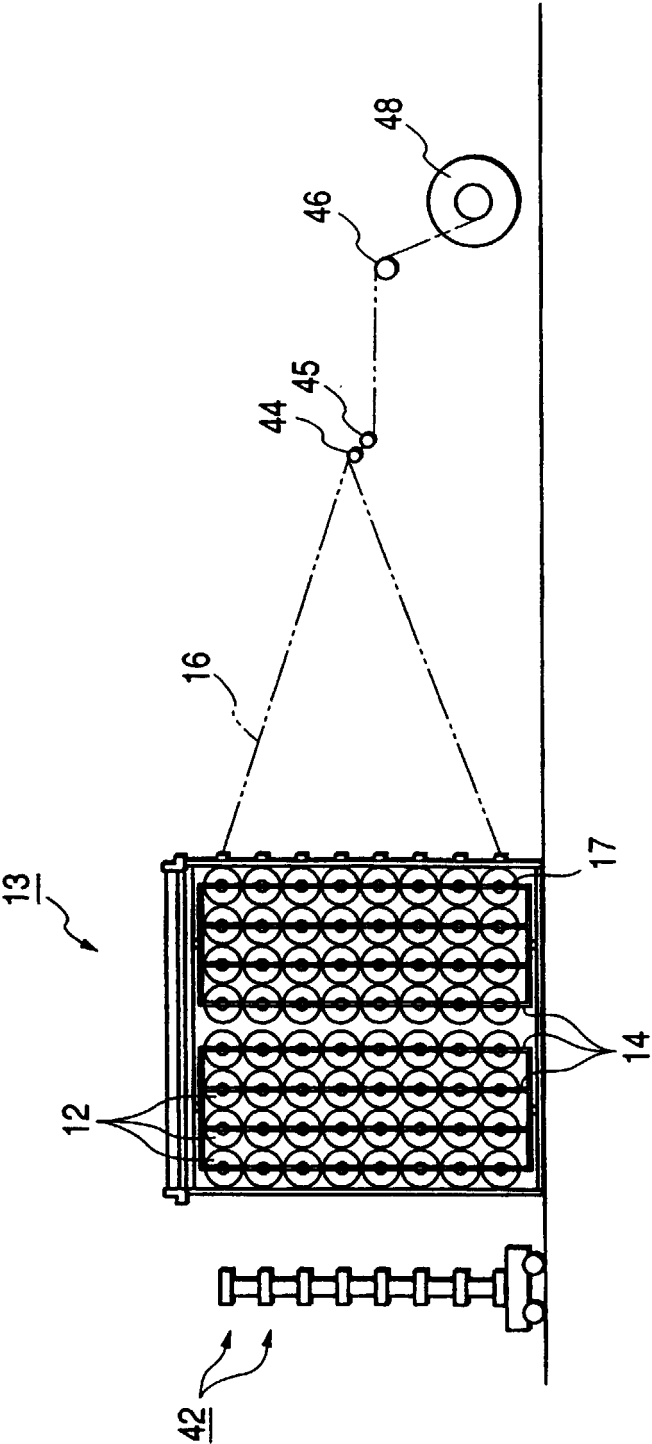


FIG. 5

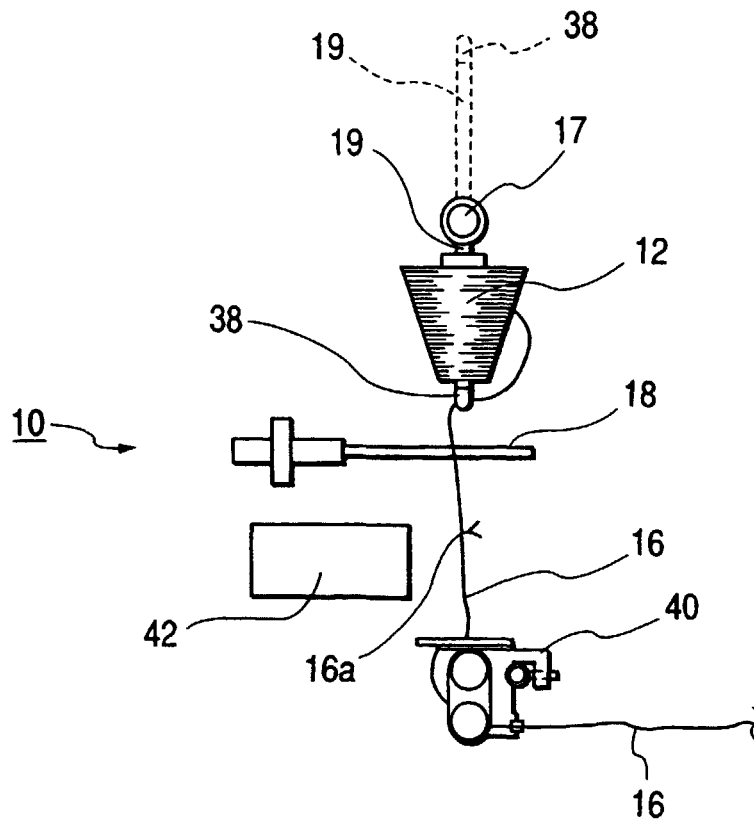


FIG. 6

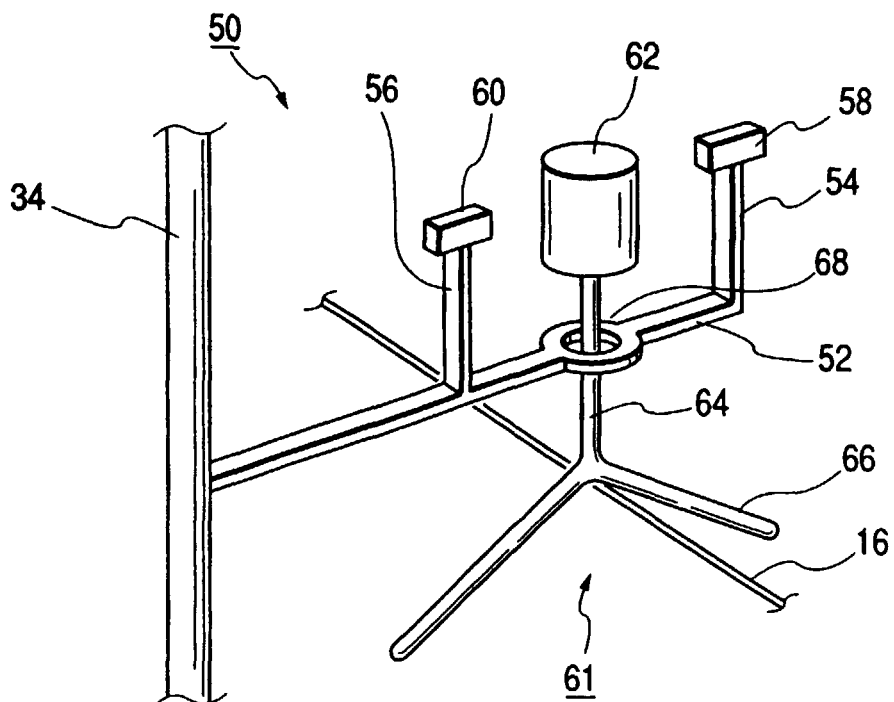
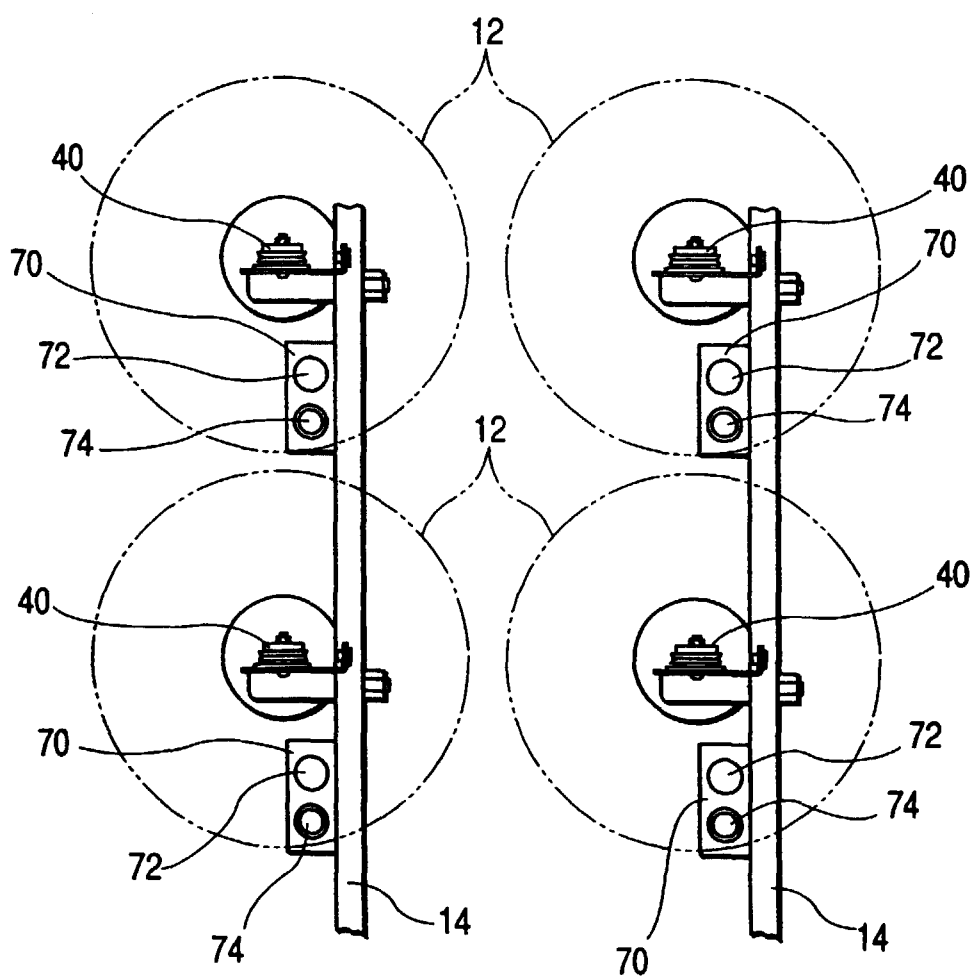


FIG. 7





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 11 4073

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
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Place of search THE HAGUE		Date of completion of the search 21 December 2000	Examiner Rebiere, J-L
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21-12-2000

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