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

(11) EP 3 147 397 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.03.2017 Bulletin 2017/13

(21) Application number: **16180976.9**

(22) Date of filing: **25.07.2016**

(51) Int Cl.:
D03D 51/00 *(2006.01)* ***D03D 49/20*** *(2006.01)*
D03D 49/10 *(2006.01)* ***D03J 1/20*** *(2006.01)*

(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
Designated Validation States:
MA MD

(30) Priority: **15.09.2015 JP 2015181291**

(71) Applicant: **TSUDAKOMA KOGYO KABUSHIKI KAISHA**
Kanazawa-shi,
Ishikawa-ken 921-8650 (JP)

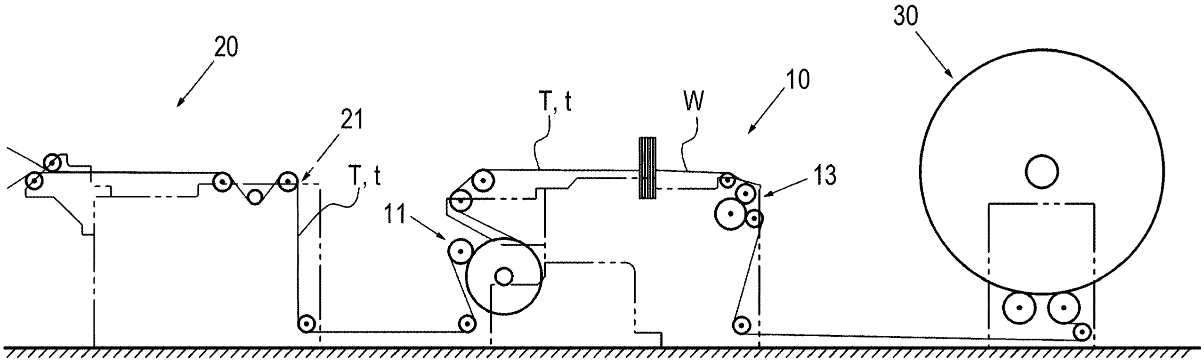
(72) Inventors:
- **MATSUYAMA, Yutaka**
  Ishikawa-ken 921-8650 (JP)
- **ITO, Naoyuki**
  Ishikawa-ken 921-8650 (JP)
- **MIZUI, Yoshiro**
  Ishikawa-ken 921-8650 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) WEAVING MANAGEMENT METHOD AND WEAVING MANAGEMENT APPARATUS FOR TIRE CORD FABRIC WEAVING LOOM

(57) In a tire cord fabric weaving loom (10), in a process of a warp feeding operation that is performed by moving a warp row (T) toward a let-off mechanism (11) in a state in which rotation of the loom main shaft (MS) is stopped while the loom is stopped, a movement amount of a movement member that moves as the warp row (T) moves is detected, a return length of the tire cord fabric (W), which is a length of the tire cord fabric (W) that has been returned due to the warp feeding operation, is obtained on the basis of the detected movement amount, and the obtained return length is subtracted from a woven length that is stored in a loom control apparatus (100).

FIG. 1



EP 3 147 397 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a tire cord fabric weaving loom for weaving a tire cord fabric including a tire fabric section. In particular, the present invention relates to a tire cord fabric weaving loom that successively obtains a weaving amount of the tire cord fabric on the basis of a rotation amount of a main shaft of the loom (corresponding to a "loom main shaft" in the present invention, and, hereinafter, also simply referred to as a "main shaft") during weaving and that stores the weaving amount of the tire cord fabric that has been woven as a woven length in a loom control apparatus.

2. Description of the Related Art

[0002] In a loom, when a weaving flaw (weaving defect) that is unacceptable in terms of quality is found in a woven fabric, a so-called "flaw returning operation" is performed to repair the flaw. The flaw returning operation is an operation in which the fabric is returned to a state before the weaving flaw was generated. To be more specific, in the flaw returning operation, the loom is returned to a state before an area of the fabric between the cloth fell and a portion where a weaving flaw occurred was woven. The loom is operated so that weft yarns that have been woven into the area are extracted from the fabric and so that the cloth fell of the fabric from which the weft yarns have been extracted is returned to a position corresponding to the forward-most position of a reed of the loom.

[0003] In a loom for weaving a general fabric (hereinafter, referred to as a "normal loom"), the flaw returning operation is performed as follows: the loom main shaft (driving motor) is rotated backward one rotation at a time; a weft yarn is extracted from the fabric by placing the weft yarn in a pick-finding state (a state in which the warp is shed and the weft yarn is exposed to the cloth fell) each time the loom main shaft is rotated backward; and the operation of rotating the loom main shaft and extracting a weft warn is repeatedly performed until all weft yarns in the area are extracted.

[0004] However, in a case where the loom is a tire cord fabric weaving loom (hereinafter, also referred to as a "tire cord loom"), the flaw returning operation is generally performed without rotating the main shaft, as described in Japanese Unexamined Patent Application Publication No. 2012-149365.

[0005] To be more specific, a tire cord loom is a loom for weaving a tire cord fabric including a tire fabric section, which has a weft density (for example, 1 yarn/inch) that is considerably lower than that of a general fabric. The tire cord fabric is a rubber reinforcement fabric that is used to produce a carcass layer that forms a skeleton of a rubber tire. The carcass layer is manufactured by coating the tire fabric section of the tire cord fabric with a rubber material. The tire cord loom continuously weaves one unit of tire fabric section, which is a part of the tire fabric section having a preset woven length.

[0006] However, the tire cord fabric woven by the tire cord loom includes not only the tire fabric section but also a tabby section. The tabby section forms a boundary of one unit of the tire cord section and has a weft density as high as that of a general fabric so as to keep the shape of the fabric of the tire cord section. Accordingly, the tire cord loom weaves the tire cord fabric through a continuous weaving process in which a step of weaving the one unit of the tire cord section and a step of weaving the tabby section having a predetermined length are repeatedly performed. Only the tire cord section of the tire cord fabric, which is woven in this way, is used as a product (used for a rubber tire). The tabby section is discarded in a manufacturing process of a rubber tire. Accordingly, a fabric quality is not required for the tabby section.

[0007] While weaving the tire cord fabric with the tire cord loom, if a weaving flaw (a weaving defect that causes a quality problem) is found in the tire fabric section, the flaw returning operation is performed as described above. However, in the tire fabric section of the tire cord fabric, because the weft density is very low as described above and the warp holds the weft with only a weak force, it is possible to extract a weft yarn without placing the weft yarn in a pick-finding state. Therefore, in contrast to that of a normal loom, the flaw returning operation of the tire cord loom is performed without rotating the main shaft backward. To be specific, the flaw returning operation is performed as follows: first, an operator (loom operator) removes weft yarns from an area of a tire fabric section on the loom from which it is necessary (or possible) to remove the weft yarns; then, the operator, for example, manually presses a button to operate (rotate backward) only a take-up mechanism and a let-off mechanism to move the cloth fell position of the tire fabric section, from which the weft yarns have been removed, toward the warp let-off side. Thus, in a tire cord loom, the flaw returning operation is performed as an operation (warp feeding operation) of feeding, toward the warp let-off side, a part of a woven tire fabric section from which weft yarns have been removed and in which only warp yarns remain.

[0008] Examples of a weaving defect of a tire cord fabric (tire fabric section) that may cause a quality problem include a case where tuck-in of an end portion of weft yarns, which is generally performed when weaving a tire cord section as described in Japanese Unexamined Patent Application Publication No. 2011-111700, is not normally (desirably) performed. Such a state in which tuck-in is not normally performed (tuck-in failure) is not problematic if it occurs temporarily. However, if it occurs due to a mechanical problem or a control-related problem, the tuck-in failure may continuously occur after the first time it occurs. Such a case causes a quality problem of the tire fabric section.

[0009] Moreover, in contrast to a general loom, which uses warp yarns released from a warp beam, a tire cord loom generally uses warp yarns released from a creel device that is independent of the loom and that includes yarn supply packages in the same number as the number of the warp yarns. In this case, if some of the yarn supply packages have a quality problem, the problem causes a defect in a warp yarn that extends in the warp direction in a tire fabric section. Also in such a case, the flaw returning operation is performed to remove the portion in which the warp yarn is defective.

[0010] Weaving of the tire fabric section, which has a very low weft density as described above, is performed with a warp feeding velocity that is considerably higher than that of a normal loom. Therefore, at a time when an operator finds the weaving defect, defective weaving may have been performed by an amount corresponding to several tens of meters of the warp (which may be as long as 100 m). In this case, an operator performs an operation of returning the several tens of meters of the fabric (warp row).

SUMMARY OF THE INVENTION

[0011] It is required that looms, including tire cord looms, to manage the woven length of a fabric that has been woven during weaving as accurately as possible. For example, the woven length is calculated on the basis of the rotation amount (the number of rotations) of the main shaft during weaving and the weft density of a fabric that is being woven. During weaving, a weaving amount (weaving amount for one rotation of the main shaft (for one loom cycle)) corresponding to the weft density is added each time the main shaft rotates once. The accumulated value is stored in a control device of the loom or the like and managed.

[0012] In the case of a normal loom, when a flaw returning operation is performed as described above, the main shaft is rotated backward one rotation at a time in the flaw returning operation. Therefore, each time the main shaft is rotated backward once, a weaving amount corresponding to one rotation of the main shaft is subtracted from the accumulated value, so that the correspondence between the accumulated value stored in the loom (a woven length obtained by calculation) and the actual woven length is maintained.

[0013] However, in the case of a tire cord loom, the flaw returning operation (warp feeding operation) is not performed by rotating (rotating backward) the main shaft but is performed by rotating only the take-up device and the let-off mechanism backward as described above. Therefore, with existing tire cord looms, when the flaw returning operation is performed, it is not possible to obtain the length of the area that is returned due to the flaw returning operation. As a result, although the actual woven length is decreased due to the flaw returning operation, the accumulated value is maintained at a value before the flaw returning operation was performed. Therefore, with existing tire cord looms, when the flaw returning operation is performed, the woven length stored in the loom control apparatus (the accumulated value) becomes different from the actual woven length. Moreover, as described above, the flaw returning operation of the tire cord loom may be performed so as to return several tens of meters of the warp. Accordingly, existing tire cord looms have a problem in that it is not possible to manage the woven length accurately when the flaw returning operation is performed.

[0014] An object of the present invention, which addresses the problem with existing tire cord looms, is to enable a tire cord fabric weaving loom to manage the woven length accurately even when a flaw returning operation is performed.

[0015] To achieve the object, a weaving management method according to the present invention, which is used in a tire cord fabric weaving loom as described above, includes detecting a movement amount of a movement member, which moves as a warp row moves, in a process of a warp feeding operation that is performed by moving the warp row toward a let-off mechanism in a state in which rotation of a loom main shaft is stopped while the loom is stopped; obtaining a return length of the tire cord fabric that has been returned due to the warp feeding operation on the basis of the detected movement amount; and subtracting the obtained return length from the stored woven length stored in the loom control apparatus.

[0016] A weaving management apparatus according to the present invention, which is used in the tire cord fabric weaving loom as described above in which the loom control apparatus causes a take-up mechanism and a let-off mechanism to rotate backward while the loom is stopped to perform a warp feeding operation with which a warp row is moved toward the let-off mechanism in a state in which rotation of a loom main shaft is stopped, includes a detection device that detects a movement amount of a movement member, which moves as the warp row moves, during the warp feeding operation; and a computing device that obtains a return length of the tire cord fabric that has been returned due to the warp feeding operation on the basis of a detected movement amount that is the movement amount of the movement member detected by the detection device.

[0017] In the present invention, the warp feeding operation refers to the flaw returning operation of the tire cord loom. To be specific, the flaw returning operation is an operation for returning a woven fabric to a state before an area including a weaving defect was woven. In the case of a tire cord loom, the flaw returning operation is performed when a weaving defect as described above is found in a tire fabric section, for which a fabric quality is required. As described above, the flaw returning operation of the tire cord loom is performed by extracting weft yarns from the woven tire fabric section beforehand so that the tire cord section has only the warp yarns and by continuously feeding the warp row toward the let-off mechanism. Accordingly, because the operation that the tire cord loom performs for flaw returning can be regarded as an operation of feeding the warp row, in the present invention, the flaw returning operation is a warp feeding operation. The flaw returning operation (warp feeding operation) is an operation for returning the fabric, and the return length of the fabric that is returned corresponds to the movement amount of the warp row that is fed as described above.

[0018] In the present invention, a "return length" (to be obtained) is not limited to the length of the entirety of the area that is returned (needs to be returned) by performing the warp feeding operation (flaw returning operation) as described above. The return length may be the length of a part of the area. That is, in the present invention, the phrase "obtaining a return length" includes the following two cases: a case where the length of the area that has been returned due to the warp feeding operation is obtained as the return length at a time after the warp feeding operation has been finished; and a case where the length of a part of the fabric that has been returned before a certain time during the warp feeding operation is obtained as the return length and this is repeatedly performed until the warp feeding operation is finished (on and after the second time, the length of a part that has been returned since the previous time at which the previous return length was obtained is obtained). The latter case includes the following two cases: a case where, at each predetermined interval, the length of the tire cord fabric returned in the interval is obtained as the return length; and a case where a predetermined length of the tire cord fabric is set as a predetermined return length, and the return length is obtained by detecting the time at which the tire cord fabric having the predetermined return length is returned.

[0019] In the present invention, the "detected movement amount" is not limited to a detection value of the movement amount of the movement member itself. The detected movement amount may be a detection value of a driving amount of a driving device (motor or the like) in a case where the movement member is a member that is driven by the driving device. That is, the movement amount of the movement member is proportional to the driving amount of the driving device, and the movement amount of the driving device can be used instead of the movement amount of the movement member. Therefore, the detected movement amount is not limited to a detection value of the movement amount of the movement member that is detected directly, and may be a detection value of the movement amount of the driving device, which can be regarded as the movement amount of the movement member that is indirectly detected.

[0020] Moreover, in the present invention, the term "loom control apparatus" refers a control system of a loom in general, which incudes a take-up control device that controls driving of the take-up mechanism and a let-off control device that controls driving of the let-off mechanism. A memory unit is not limited to a single memory, and may include a plurality of memories.

[0021] In the present invention described above, the movement member may be a take-up roller of the take-up mechanism, over which the tire cord fabric that has been woven is looped and which is rotated by a take-up motor, and a rotation amount of the take-up roller may be detected as the detected movement amount. Then, the return length may be obtained on the basis of the detected rotation amount of the take-up roller as the detected movement amount. In this case, the detection device as a device is a rotation detection device that detects the rotation amount of the take-up roller, and the computing device obtains the return length on the basis of the detected rotation amount. The detected rotation amount of the take-up roller is not limited to a detection value of the rotation amount of the take-up roller itself, and may be a detection value of the rotation amount of the take-up motor, which is a driving device that rotates the take-up roller as described above.

[0022] The tire cord fabric weaving loom to which the present invention is applied may regard one loom cycle that corresponds to one rotation of the loom main shaft as one step of weaving, count the steps successively as weaving progresses, and store a count value of the steps. The count value may be stored in the memory unit. Here, one loom cycle corresponds to one rotation of the loom main shaft as described above. That is, a loom performs a series of movements (weaving cycle) in which one weft insertion is performed while the loom main shaft rotates once, and the loom performs weaving by repeatedly performing the series of movements. Therefore, one weaving cycle (one loom cycle), which is repeatedly performed, corresponds to one rotation of the loom main shaft.

[0023] In the above case, the number of steps corresponding to the return length of the tire cord fabric that has been returned due to the warp feeding operation may be obtained on the basis of the detected movement amount of the movement member detected during the warp feeding operation, and the obtained number of steps may be subtracted from the stored count value. As a device, the computing device may have a function of obtaining the number of steps corresponding to the return length of the tire cord fabric that has been returned due to the warp feeding operation.

[0024] In the process of the warp feeding operation, an imaginary main shaft rotation signal may be output each time the detected movement amount coincides with a unit movement amount that is a movement amount of the movement member in the one step during weaving; and each time the imaginary main shaft rotation signal is output, a weaving amount for the one step may be subtracted as the return from the stored woven and one may be subtracted from the stored count value as the number of steps. In this case, as an apparatus, the movement amount of the movement member in the one step may be stored as a unit movement amount in the memory unit; the apparatus may include a comparator that compares the detected movement amount with the unit movement amount and that outputs an imaginary main shaft rotation signal to the computing device each time the detected movement amount coincides with the unit movement amount; and the computing device may have a function of changing the woven length stored in the memory unit to a woven length obtained by subtracting the weaving amount for the one step each time the comparator outputs the imaginary main shaft rotation signal, and a function of subtracting one as the number of steps from the count value of the steps stored in the memory unit.

[0025] With the present invention, when the warp feeding operation as described above is performed in the tire cord loom, the movement amount of the movement member, which moves as the warp row moves during the warp feeding operation, is detected; and the return length of the tire cord fabric returned due to the warp feeding operation is obtained on the basis of the detection value. Then, by subtracting the obtained return length from the woven length stored in the loom control apparatus, it is possible to make the woven length stored in the loom control apparatus coincide with the actual woven length after the warp feeding operation is performed. Thus, even when the warp feeding operation is performed without rotating the main shaft in the tire cord loom, which obtains a woven length (weaving amount) on the basis of the rotation amount of the main shaft, it is possible to manage the woven length accurately. The subtraction of the return length from the stored woven length may be automatically performed by the loom control apparatus (computing device) or by an operator by manually operating an input device of the loom or the like.

[0026] In looms, including tire cord looms, a woven fabric is looped over a take-up roller of a take-up mechanism, and the fabric is fed toward a cloth roller as the take-up roller rotates, and the weft density of a fabric that is woven is controlled on the basis of the rotation amount of the take-up roller. In other words, the take-up roller is rotated so that the weft density of the woven fabric coincides with a set value of the weft density, and driving of the take-up motor that rotates the take-up roller is controlled in accordance with the set value. The driving of the take-up motor is controlled by performing proportional control with respect to the rotation amount of the main shaft so that the take-up roller rotates by a rotation amount corresponding to the weft density each time the main shaft rotates once (one loom cycle).

[0027] Thus, in a loom (tire cord loom), the relationship between a weaving amount for one rotation of the main shaft (one loom cycle) corresponding to the weft density and the rotation amount of the take-up roller (take-up motor) is obtained (set) beforehand. Therefore, in the present invention, by using the take-up roller as the movement member and by using the rotation amount of the take-up roller (take-up motor) that is detected (detected rotation amount) as the detected movement amount, it is possible to easily obtain the length of the warp row (returned fabric) moved due to the warp feeding operation on the basis of the detected rotation amount. Accordingly, the present invention can be easily realized by using such a structure.

[0028] In looms, including tire cord looms, a shedding device, which drives a heald frame to cause warp yarns to perform a shedding motion, drives the heald frame in synchronism with the rotation of the main shaft so that the heald frame moves in accordance with a predetermined shedding pattern (such as a plain weaving pattern) during weaving. In the shedding pattern, two or more loom cycles (steps) constitute one repeat. That is, in the shedding pattern, one repeat includes two or more shedding steps. Accordingly, the shedding device repeatedly performs a series of movements in each cycle of the loom corresponding to one repeat of the shedding pattern, and, at each time in one repeat, the shedding device is in a phase state corresponding to the time.

[0029] In the tire cord loom, because the warp feeding operation is performed in a state in which the main shaft is stopped as described above, the shedding device is also stopped during the warp feeding operation. Accordingly, when the loom is stopped and the warp feeding operation is performed (at a time at which the loom is restarted), the phase state of the shedding device is the same as that at a time at which the loom was stopped. Because the weaving state of the fabric (to what extent the fabric has been woven) is returned during the warp feeding operation, the weaving state of the fabric changes. Therefore, when the warp feeding operation is performed in such a tire cord loom, the tire cord loom may enter a state in which the weaving state of the fabric after the warp feeding operation does not correspond to the phase state of the shedding device, in other words, a state in which a shedding step at a time at which a warp yarn at a position closest to the cloth fell is inserted after the warp feeding operation does not coincide with a shedding step corresponding to the phase state of the shedding device while the loom is stopped. If the loom is restarted in such an uncoincided state, the initial weft insertion after the restart is not performed correctly, and a weaving defect occurs.

[0030] There are some looms that regard one loom cycle (one rotation of the main shaft) as one step of weaving and recognize (manage) the progress of weaving by successively counting the steps each time the main shaft rotates once. Some tire cord looms operate in the same way. The count value of the steps corresponds to the state of progress of weaving as described above, and the progress of weaving corresponds to the weaving state of the fabric during weaving.

[0031] When applying the present invention to such a tire cord loom, on the basis of the detected movement amount of the movement member detected during the warp feeding operation, by subtracting the number of steps corresponding to the return length from the count value of the steps, it is possible to make the count value correspond to the weaving state of the fabric returned due to the warp feeding operation and to recognize the weaving state of the fabric after the warp feeding operation by using the count value. Thus, on the basis of the returned count value and the phase state of the shedding device while the loom is stopped, these two can be easily made to coincide, and therefore an occurrence of a weaving defect as described above can be prevented. The subtraction may be automatically performed by the loom control apparatus (computing device) or by an operator by manually operating the input device of the loom or the like.

[0032] The subtraction of the return length from the stored woven length may be performed, for example, as follows: after the time at which the warp feeding operation is finished, the length of the entirety of the area returned due to the warp feeding operation is obtained on the basis of the detected movement amount of the movement member from the start to the end of the warp feeding operation, and the obtained length is subtracted from the stored woven length; or the weaving amount for one step is successively subtracted each time the movement amount (the unit movement amount) of the movement member is detected during the warp feeding operation, and this is repeatedly performed until the warp feeding operation finishes. The latter method is automatically performed by the loom control apparatus (computing device), because it is performed in a warp feeding process of continuously feeding the warp row.

[0033] Likewise, the subtraction of the number of steps corresponding to the return length from the stored count value of the steps may be performed, for example, as follows: after the time at which the warp feeding operation is finished, the number of steps corresponding to the detected movement amount is obtained on the basis of the detected movement amount of the movement member from the start to the end of the warp feeding operation, and the number of steps is subtracted from the stored count value; or the number of steps, which is one, is subtracted from the count value each time the movement amount (the unit movement amount) of the movement member is detected during the warp feeding operation, and this is repeatedly performed until the warp feeding operation finishes. The latter method is automatically performed by the loom control apparatus (computing device), as with the subtraction of the return length described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

Fig. 1 is a schematic side view of a tire cord weaving apparatus including a tire cord fabric weaving loom to which the present invention is applied;

Fig. 2 is a schematic side view of the tire cord fabric weaving loom to which the present invention is applied; and

Fig. 3 is a block diagram of a loom control apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

[0036] Fig. 1 illustrates a tire cord weaving apparatus 1 including a tire cord fabric weaving loom (tire cord loom) 10 to which the present invention is applied. The tire cord weaving apparatus 1 is the entire apparatus for weaving a tire cord fabric W (hereinafter, also simply referred to as a "fabric W"). The tire cord weaving apparatus 1 includes the tire cord loom 10 that weaves the tire cord fabric W, a warp supply section 20 that supplies a large number of warp yarns t to the tire cord loom 10 as a sheet-shaped warp row T, and a cloth winding device 30 that winds the tire cord fabric W woven by the tire cord loom 10.

[0037] Regarding the warp supply section 20, only a tension device 21, which is a part of the warp supply section 20 is illustrated in Fig. 1, while a creel device, which holds yarns to be used as the warp yarns t, is omitted. That is, the warp supply section 20 includes a creel device in addition to the tension device 21 shown in Fig. 1. The creel device is disposed upstream of the tension device 21 and holds yarn supply packages in the same number as the number of the warp yarns t to be supplied to the tire cord loom 10. The yarns are simultaneously released from the yarn supply packages of the creel device and supplied to the tire cord loom 10 as the warp row T. The tension device 21 of the warp supply section 20 arranges a large number of yarns, which have been released from the creel device, into a sheet-like shape and applies a predetermined tension so that the tensions of the yarns become uniform. Description of the structure of the tension device 21, which is publicly known, will be omitted.

[0038] Thus, the tire cord loom 10 of the tire cord weaving apparatus 1 differs from a normal loom in that the tire cord loom 10 does not include a section for supplying warp yarns and a section for winding a fabric that has been woven. Instead, these sections exist independently from the tire cord loom 10 as the warp supply section 20 and the cloth winding device 30. In the tire cord weaving apparatus 1, the tire cord loom 10 weaves the fabric W by using the warp row T supplied from the warp supply section 20 as described above. The fabric W woven by the tire cord loom 10 is fed out from the tire cord loom 10 and wound by the cloth winding device 30, which is independent from the tire cord loom 10. The cloth winding device 30, which is also called an "independent winding device", is of a type that winds the fabric W in a state in which a cloth roll, in which the fabric W is wound around a cloth roller, is placed on a pair of rollers. Because the structure of the cloth winding device 30 is known, description of the structure will be omitted.

[0039] The tire cord loom 10 is the same as a normal loom in the structure (a shedding device, a weft insertion device, and the like) of a section that performs weft insertion (weft insertion section). As described above, the tire cord loom 10 does not include a section that supplies warp yarns. Instead, the tire cord loom 10 includes a let-off mechanism 11. To be specific, a normal loom feeds warp yarns, which are wound around a warp beam, in the form of a warp row toward the weft insertion section by rotating a let-off beam, which is included in the loom. At the same time, the loom controls the tension of the warp yarns by controlling the rotation of the warp beam. In contrast, in the tire cord loom 10, the warp row T is supplied from the warp supply section 20 as described above. In the tire cord loom 10, the warp row T, which is supplied from the warp supply section 20, is fed by the let-off mechanism 11 toward the weft insertion section. At the same time, the let-off mechanism 11 controls the tension of the warp yarns t of the warp row T.

[0040] To be specific, the let-off mechanism 11 includes a let-off roller 11 a, a nip roller 11 b, and a let-off motor ML (Fig. 2). The let-off roller 11 a is rotated so as to feed the warp row T, which is looped over the let-off roller 11 a, toward the weft insertion section. The nip roller 11 b guides the warp row T toward the peripheral surface of the let-off roller 11 a and is in pressed contact with the let-off roller 11 a so as to nip the warp row T between the nip roller 11 b and the let-off roller 11 a. The let-off motor ML rotates the let-off roller 11 a. Because the nip roller 11 b is in pressed contact with the let-off roller 11 a as described above, the nip roller 11 b is rotated as the let-off motor ML rotates the let-off roller 11 a.

[0041] The warp row T, which is supplied from the warp supply section 20, is diverted (guided) by a guide roller 15c toward the nip roller 11 b. Then, the warp row T is looped over the nip roller 11 b to be guided to a nip between the nip roller 11 b and the let-off roller 11a. After passing through the nip, the warp row T is looped over the peripheral surface of the let-off roller 11 a. Accordingly, as the let-off motor ML rotates the let-off roller 11 a and the nip roller 11 b is rotated as described above, the warp row T is actively fed onto the peripheral surface of the let-off roller 11 a via the nip and is fed toward the weft insertion section as the let-off roller 11 a rotates.

[0042] The warp row T, which is fed from the let-off mechanism 11, is looped over a tension roller 15b via a guide roller 15a and guided toward the weft insertion section. As with a normal loom, a tension detector 15d is connected to the tension roller 15b. The tension detector 15d detects a load that the tension roller 15b receives from the warp row T due to the tension of the warp yarns t. On the basis of the detection value, the tension of the warp yarns t of the warp row T is detected. On the basis of the detection value, driving of the let-off motor ML, which rotates the let-off roller 11 a, is controlled so that the tension of the warp yarns t is maintained at a desired target tension. The driving of the let-off motor ML is controlled by a let-off control device 120 of a loom control apparatus 100, which will be described below.

[0043] In the weft insertion section, a plurality of heald frames HF cause the warp row T (warp yarns t) to perform a shedding motion, a weft insertion device (not shown) inserts a weft yarn into a shed formed by the shedding motion, and a reed R beats the inserted weft against the cloth fell. Accordingly, the weft yarn is woven into the warp row T, and the tire cord fabric W is woven. The fabric W, which has been woven in this way, is guided toward a take-up mechanism 13 via a guide roller 17a.

[0044] The reed R is driven by a driving mechanism (not shown), which is driven by the main shaft MS, so as to reciprocate once in each cycle of the loom (each loom cycle). The heald frames HF are driven by a shedding device (not shown), which is driven by the main shaft MS (or a dedicated driving motor), so as to perform a motion in accordance with a predetermined shedding pattern. The main shaft MS, which drives the shedding device, is rotated by a main motor MM with a velocity corresponding to a preset rotation velocity of the loom. Although the tire cord fabric W has a fabric structure, the purpose of inserting weft yarns is only to maintain the arranged state of the warp row T. Therefore, the texture of the tire cord fabric W is simple, and, in general, the shedding pattern is a plain weaving pattern. A crank shedding device is an example of a shedding device that causes the heald frames HF to perform a shedding motion in accordance with the plain weaving pattern.

[0045] The take-up mechanism 13, which has the same structure as that of a normal loom, includes a take-up roller 13a, a pair of press rollers 13b and 13c, and a take-up motor MT. The take-up roller 13a is rotated so as to feed the fabric W, which is looped over the take-up roller 13a, with a predetermined feed velocity (feed amount per unit time). The press rollers 13b and 13c are in pressed contact with the take-up roller 13a so as to nip the fabric W between the take-up roller 13a and the press rollers 13b and 13c. The take-up motor MT rotates the take-up roller 13a. Because the press rollers 13b and 13c are in pressed contact with the take-up roller 13a as described above, the press rollers 13b and 13c rotate as the take-up motor MT rotates the take-up roller 13a.

[0046] In the take-up mechanism 13, the fabric W is first looped over the press roller 13b on the upstream side, is thereby guided toward the nip between the press roller 13b and the take-up roller 13a, and is looped over the peripheral surface of the take-up roller 13a via the nip. Subsequently, the fabric W passes through the nip between the take-up roller 13a and the press roller 13c on the downstream side, which is on the peripheral surface of the take-up roller 13a, is looped over the press roller 13c, and is guided toward a guide roller 17b disposed below the take-up mechanism 13.

[0047] Thus, in the take-up mechanism 13, the fabric W is nipped between the take-up roller 13a and the pair of press rollers 13b and 13c. Therefore, as the take-up motor MT rotates the take-up roller 13a and as the press rollers 13b and 13c are rotated as described above, the fabric W is fed with a feed velocity corresponding to the rotation velocity of the take-up roller 13a. A take-up control device 130 of the loom control apparatus 100 (described below) controls driving of the take-up motor MT, which rotates the take-up roller 13a. The fabric W fed out from the take-up mechanism 13 is looped over the guide roller 17b and diverted, is fed toward the cloth winding device 30 described above, and is wound around a fabric roll (cloth roller) on the cloth winding device 30.

[0048] Fig. 3 illustrates the loom control apparatus 100 of the tire cord loom 10 described above. As illustrated in Fig. 3, the loom control apparatus 100 includes a main control device 110; the let-off control device 120, which controls driving of the let-off motor ML of the let-off mechanism 11; and the take-up control device 130, which controls driving of the take-up motor MT of the take-up mechanism 13. The main control device 110 includes a controller 113, which performs control of driving of the main motor MM and the like; a memory 111, which is an example of a memory unit and which is connected to the controller 113; and a computing unit 115, which is an example of a computing device and which is connected to the controller 113 and the memory 111. The let-off control device 120 and the take-up control device 130 are connected to the controller 113 of the main control device 110.

[0049] Moreover, an input device 19 is connected to the memory 111 of the main control device 110. The input device 19 has, for example, a touch screen and allows an operator to input weaving conditions, such as various setting values and conditions, by using a setting screen and the like displayed on the screen. The weaving conditions input through the input device 19 are sent to the memory 111 of the main control device 110 and stored in the memory 111. The input device 19 also functions as a display device that displays weaving-related information and the like, which have been sent from the computing unit 115 to the memory 111 and stored in the memory 111, on the screen. Moreover, the input device 19 also functions as an operation unit that allows an operator to operate some devices of the loom by pressing operation buttons and the like displayed on the screen.

[0050] Examples of weaving conditions input through the input device 19 include the following: a set value of the weft density (set weft density) of each of a tire fabric section and a tabby section, as fabric sections included in the tire cord fabric W; a set value of the rotation velocity (set rotation velocity) of the main shaft MS when weaving each fabric section; and a weaving amount (set weaving amount) of each fabric section. The weaving conditions further include a target tension value (set tension value) for each fabric section, which are used by the let-off mechanism 11 to control the tension of the warp yarns t as described above.

[0051] During weaving, the main control device 110 controls driving of the main motor MM in accordance with the set rotation velocity for each fabric section and the set weaving length for each fabric section, which have been input through the input device 19 and stored in the memory 111 of the main control device 110 as described above. For example, when weaving the tire fabric section, the controller 113 of the main control device 110 reads the set rotation velocity for the tire fabric section from the memory 111 and controls driving of the main motor MM so that the main shaft MS is rotated with the set rotation velocity. Thus, the tire cord loom 10 performs weaving in an operation state in which the main shaft MS is rotated with the set rotation velocity for the tire fabric section.

[0052] An encoder EN1 that detects the rotation amount of the main motor MM is connected to the main motor MM. The encoder EN1 outputs a rotation amount signal S1, which indicates the rotation amount of the main motor MM, to the computing unit 115 of the main control device 110. The rotation amount of the main motor MM is proportional to the rotation amount of the main shaft MS with a predetermined ratio. Accordingly, the computing unit 115 can recognize the rotation amount of the main shaft MS on the basis of the rotation amount signal S1 from the encoder EN1. Then, the computing unit 115 outputs a signal corresponding to the rotation amount of the main shaft MS to the controller 113. The main control device 110 (the controller 113) also outputs control signals and the like to other devices (for example, a weft insertion device) of the tire cord loom 10. The controller 113 outputs the control signals and the like on the basis of operation conditions for the other devices, which are included in the weaving conditions stored in the memory 111, and the signal indicating the rotation amount of the main shaft MS, which is sent from the computing unit 115. Thus, the controller 113 controls the tire cord loom 10 so that the other devices perform predetermined motions (for example, weft insertion motions of the weft insertion device) at predetermined timings.

[0053] On the basis of rotation amount signal S1 from the encoder EN1, the computing unit 115 can recognize that the main shaft MS is rotated once each time the rotation amount of the main motor MM becomes a rotation amount corresponding to one rotation of the main shaft MS. One rotation of the main shaft MS corresponds to one loom cycle, and one loom cycle is regarded as corresponding to one step of weaving (one weaving step) that is continuously performed. Each time the computing unit 115 recognizes that the main shaft MS is rotated once as described above, the computing unit 115 counts up (increments) the number of weaving steps, which has been obtained, by one. The counted number of weaving steps (count value) is stored in the memory 111 as the number of weaving steps performed in weaving. The count value of weaving steps is reset each time the fabric sections (the tire fabric section and the tabby section) are switched, and the count is restarted when weaving of the switched fabric section is started.

[0054] Moreover, the main control device 110 has a function of calculating the woven length of the fabric W that has been woven. To be more specific, the fabric W is woven by a weaving amount corresponding to a set weft density in each loom cycle (each weaving step). Each time the computing unit 115 of the main control device 110 recognizes that the main shaft MS is rotated once (one loom cycle is performed) as described above when weaving each fabric section, the computing unit adds a weaving amount (weaving amount obtained from the set weft density) for one loom cycle to the woven length that has been obtained. For example, if it is assumed that the weft density of the tire fabric section is one yarn/inch, a weaving amount for one loom cycle (one weaving step) is one inch, and the computing unit 115 adds the weaving amount (one inch) to the woven length each time the main shaft MS rotates once.

[0055] A weaving amount that is obtained by successively adding the weaving amount for one loom cycle in this way is the woven length of the fabric W that has been woven, and the obtained woven length is stored in the memory 111. However, a method of calculating the woven length is not limited to the method of successively adding the weaving amount for one loom cycle as described above. The woven length may be calculated, at a time at which the woven length is required, from the count value of weaving steps at the time, which is stored in the memory 111, and the set weft density.

[0056] Regarding the woven length, which is obtained as described above, the memory 111 stores the woven length of a fabric section that is being woven and the woven length from the time at which weaving was started. The woven length of the fabric section that is being woven is reset when the fabric section to be woven is switched. The woven length stored in the memory 111 in this way can be displayed on the screen of the input device 19. An operator can recognize the progress of weaving from the display.

[0057] Moreover, the main control device 110 has a function of changing the rotation velocity of the main shaft MS (the main motor MM) to switch the weaving section to be woven on the basis of the woven length obtained as described above. That is, as described above, the weft density differs considerably between the tire fabric section and the tabby section of the tire cord fabric W. The tire cord loom 10 weaves these fabric sections by changing the rotation velocity of the main shaft MS. To do so, in the main control device 110, the computing unit 115 has a function of comparing the obtained woven of the fabric section that is being woven and a set weaving amount that is stored in the memory 111 and that is set for the fabric section that is being woven. For example, while weaving the tire fabric section, the computing unit 115 successively compares the woven length of the tire fabric section, which is being woven, and the set weaving amount of the tire fabric section stored in the memory 111. When the woven length of the tire fabric section, which is being woven, reaches the set weaving amount, the computing unit 115 outputs a switching command signal for switching the fabric section to the controller 113.

[0058] When the switching command signal is input, the controller 113 changes the control state of the main motor MM so as to change the rotation velocity of the main motor MM. To be specific, when the switching command signal is input in a state in which the controller 113 controls driving of the main motor MM in accordance with the set rotation velocity for weaving the tire fabric section, the controller 113 reads the set rotation velocity for weaving the tabby section from the memory 111 and changes the control state of the main motor MM to a control state corresponding to the set rotation velocity for weaving the tabby section. As a result, the main shaft MS is rotated with a rotation velocity that is substantially equal to the set rotation velocity for weaving the tabby section.

[0059] In the take-up mechanism 13, when the main shaft MS is rotated as described above during weaving, the take-up roller 13a is rotated so as to feed the fabric W by an amount corresponding to the set weft density of a fabric section that is being woven while the main shaft MS rotates once. The rotation amount of the take-up roller 13a (take-up rotation amount) for each rotation of the main shaft MS can be obtained beforehand from the set weft density and the diameter of the take-up roller 13a. The take-up motor MT rotates the take-up roller 13a so that the take-up roller 13a rotates by such a take-up rotation amount while the main shaft MS rotates once.

[0060] As described above, the take-up control device 130 controls driving of the take-up motor MT. Driving of the take-up motor MT is controlled on the basis of the rotation amount of the main motor MM, which rotates the main shaft MS, so that the take-up roller 13a is rotated as described above in accordance with the rotation of the main shaft MS. To do so, the rotation amount signal S1 from the encoder EN1 is input to the take-up control device 130. The set weft density of the fabric section that is being woven, which is one of the set weft densities of the fabric sections stored in the memory 111, is input to the take-up control device 130.

[0061] On the basis of the rotation amount signal S1 from the encoder EN1 and the set weft density of the fabric section that is being woven, the take-up control device 130 controls driving of the take-up motor MT so that the take-up roller 13a is rotated by the take-up rotation amount while the main shaft MS rotates once. That is, the take-up control device 130 controls driving of the take-up motor MT so that the rotation amount of the take-up motor MT becomes a driving rotation amount with which the take-up roller 13a is rotated by the take-up rotation amount while the main motor MM rotates by an such an amount that the main shaft MS is rotated once. Thus, the take-up control device 130 drives the take-up motor MT in synchronism with the main motor MM and in proportion to the rotation of the main motor MM so that the take-up motor MT rotates by the driving rotation amount for each rotation amount of the main motor MM with which the main shaft MS is rotated once.

[0062] An encoder EN2 that detects the rotation amount of the take-up motor MT is connected to the take-up motor MT. The encoder EN2 outputs (feeds back) a rotation amount signal S2 corresponding to the rotation amount of the take-up motor MT to the take-up control device 130, which controls driving of the take-up motor MT. During weaving, as described above, the take-up control device 130 obtains a basic velocity of the take-up motor MT by using the rotation amount signal S1 from the encoder EN1 and the set weft density of the fabric section that is being woven. Moreover, the take-up control device 130 controls driving of the take-up motor MT on the basis of a driving amount corresponding to the basic velocity and the rotation amount signal S2 from the encoder EN2.

[0063] Because the take-up mechanism 13 feeds (moves) the fabric W as described above, the warp row T (warp yarns t), which is continuous with the fabric W at the cloth fell, is pulled by the fabric W toward the take-up mechanism 13. Therefore, in the let-off mechanism 11, the let-off motor ML rotates the let-off roller 11 a, which feeds the warp row T, so that the warp row T (warp yarns t) moves as the warp row T is pulled. As described above, the let-off control device 120 controls driving of the let-off motor ML.

[0064] To do so, the rotation amount signal S1 from the encoder EN1 is input to the let-off control device 120; and the set weft density of the fabric section that is being woven, which is one of the set weft densities of the fabric sections stored in the memory 111, is input to the let-off control device 120. On the basis of the rotation amount signal S1 from the encoder EN1 and the set weft density of the fabric section that is being woven, the let-off control device 120 obtains the basic velocity for controlling driving of the let-off motor ML.

[0065] However, the let-off control device 120 controls driving of the let-off motor ML so that the tension of the warp yarns t fed by the let-off roller 11 a coincides with a predetermined target tension for the fabric section that is being woven. To do so, a detection signal indicating a detection value obtained by the tension detector 15d described above is input to the let-off control device 120. Moreover, the set tension value for the fabric section that is being woven, which is one of the set tension values for the fabric sections stored in the memory 111, is input to the let-off control device 120. The let-off control device 120 compares the set tension value with a detected tension value that is obtained from the detection value of the tension detector 15d. On the basis of the comparison result, the let-off control device 120 adjusts the basic velocity, which has been obtained as described above, as necessary.

[0066] Moreover, an encoder EN3 that detects the rotation amount of the let-off motor ML is connected to the let-off motor ML. The encoder EN3 outputs (feeds back) a rotation amount signal S3 corresponding to the rotation amount of the let-off motor ML to the let-off control device 120, which controls driving of the let-off motor ML. During weaving, the let-off control device 120 controls driving of the let-off motor ML on the basis of a driving amount corresponding to the basic velocity (or an adjusted basic velocity) and the rotation amount signal S3 from the encoder EN3.

[0067] While the tire cord loom 10 described above is weaving a tire fabric section, if a weaving flaw (weaving defect) described above is found in the tire fabric section that has been woven, the loom is stopped and the flaw returning operation (warp feeding operation) is performed. An operator stops the loom by pressing the stop button of the loom. As described above, the flaw returning operation is performed by rotating backward the let-off roller 11 a of the let-off mechanism 11 and the take-up roller 13a of the take-up mechanism 13 simultaneously (cooperatively) in a state in which the loom is stopped, that is, in a state in which the rotation of the main shaft MS is stopped. With the tire cord loom 10, the flaw returning operation is performed in such a way that, by removing weft yarns from a woven tire fabric section beforehand so that the tire fabric section has only warp yarns, and by feeding (returning) the warp yarns toward the let-off mechanism 11 by rotating the let-off roller 11 a and the take-up roller 13a backward as described above.

[0068] For this purpose, the tire cord loom 10 includes a simultaneous backward rotation button that is used to rotate backward the let-off roller 11 a and the take-up roller 13a (hereinafter, also referred to as the "rollers") simultaneously. For example, the simultaneous backward rotation button is displayed on the touch screen of the input device 19. The let-off roller 11 a and the take-up roller 13a are rotated backward simultaneously so that these rollers respectively rotate with rotation velocities that have been set for the rollers beforehand. To do so, the rotation velocities of the rollers in the simultaneous backward rotation are stored in the memory 111 of the main control device 110 beforehand. The rotation velocities are respectively set for the let-off roller 11 a and the take-up roller 13a, which have different diameters, so that the movement amount per unit time of the fabric W that is fed (returned) as the take-up roller 13a rotates is equal to the movement amount per unit time of the warp row T that is fed (returned) as the let-off roller 11 a rotates.

[0069] When the simultaneous backward rotation button of the input device 19 is pressed, the input device 19 outputs a simultaneous backward rotation command signal for the simultaneous backward rotation to the controller 113 of the main control device 110. When the simultaneous backward rotation command signal is input, the controller 113 reads the rotation velocities from the memory 111 and outputs velocity command signals corresponding to the rotation velocities to the let-off control device 120 and the take-up control device 130, respectively. Because the simultaneous backward rotation (flaw returning operation) is performed in the state in which the main shaft MS is stopped, the basic velocity, which is obtained on the basis of the rotation amount of the main shaft MS, is not generated in each of the let-off control device 120 and the take-up control device 130. Accordingly, the let-off control device 120 controls driving of the let-off motor ML in accordance with the velocity command signal from the controller 113, and the take-up control device 130 controls driving of the take-up motor MT in accordance with the velocity command signal from the controller 113. Thus, the let-off roller 11 a and the take-up roller 13a are rotated backward with the rotation velocities stored in the memory 111.

[0070] The input device 19 continuously outputs the simultaneous backward rotation command signal to the controller 113 while the simultaneous backward rotation button on the touch screen is pressed. While the simultaneous backward rotation command signal is input to the controller 113, the controller 113 continuously outputs the velocity command signals to the let-off control device 120 and the take-up control device 130. In other words, the controller 113 outputs the velocity command signals only while the simultaneous backward rotation command signals are output from the input device 19 (while the button on the touch screen is pressed). When the output of the command signals is stopped (when the button on the touch screen is released), the controller 113 stops outputting the velocity command signals. Then, the let-off control device 120 causes the let-off motor ML to rotate backward as described above while the controller 113 outputs the velocity command signal, and the take-up control device 130 causes the take-up motor MT to rotate backward as described above while the controller 113 outputs the velocity command signal.

[0071] With such a structure, while an operator presses the simultaneous backward rotation button on the touch screen of the input device 19, the let-off roller 11 a and the take-up roller 13a are rotated backward with the aforementioned rotation velocities and the warp row T is continuously fed toward the let-off mechanism 11. When the operator releases his/her hand from the simultaneous backward rotation button, the backward rotations of the let-off roller 11 a and the take-up roller 13a are stopped (the movement of the warp row T is stopped). However, regarding the operation of feeding the warp row T when the button is on the touch screen is pressed, for example, the warp row T may be fed by a predetermined amount when the button on the touch screen is pressed once.

[0072] With the flaw returning operation (warp feeding operation) described above, an operator determines an area, from the cloth fell, of a woven tire fabric section that needs to be returned (hereinafter, simply referred to as a "return area") as a weaving defect has been found; and the return area is returned. That is, on the tire cord loom 10, the tire fabric section that is being woven is returned to a state before the return area was woven.

[0073] As described above, the warp feeding operation is performed in the state in which the main shaft MS is stopped, that is, without rotating the main shaft MS (the main motor MM) backward. Therefore, with existing tire cord looms, the woven length (the accumulated value of the weaving amount) that is obtained on the basis of the rotation amount of the main shaft MS remains the same as the woven length that was obtained at the time at which the loom was stopped before performing the flaw returning operation, unless an operator performs correction or the like. As a result, with existing tire cord looms, regarding the tire fabric section that is being woven, the actual woven length after the flaw returning operation is performed and the woven length stored in the loom control apparatus do not coincide. If these woven lengths do not coincide, it is not possible to accurately perform management of the woven length of the fabric W and the like.

[0074] In the flaw returning operation, if the operator checks the number of weft yarns extracted from the tire fabric section, it is possible to calculate the (weaving amount) of the return area, which is to be returned by the flaw returning operation as described above. However, as described above, the length of the return area to be returned by the flaw returning operation may be as long as several tens of meters, and the number of weft yarns existing in the return area may be extremely large. Accordingly, the operation of checking the number of the weft yarns by counting the weft yarns, which is extremely cumbersome and is burdensome for the operator, is not usually performed.

[0075] In contrast, with the present invention, during a warp feeding operation that is performed as a flaw returning operation of the tire cord loom 10, the return length of the tire fabric section to be returned as described above due to the warp feeding operation is obtained by using the movement amount (detected movement amount) of a movement member that moves as the warp row T (warp yarns t), which is fed toward the let-off mechanism 11 as described above, moves. Then, by subtracting the obtained return length from the woven length of the tire fabric section that has been woven, which is stored in the memory 111, regarding the tire fabric section that is being woven, it is possible to make the actual woven length after the warp feeding operation coincide with the woven length stored in the memory 111.

[0076] In the present embodiment, the movement member is the take-up roller 13a of the take-up mechanism 13, and the computing unit 115 of the main control device 110 obtains the return length on the basis of the rotation amount of the take-up motor MT (a detected rotation amount as a detected movement amount), which rotates the take-up roller 13a. Accordingly, with the present embodiment, during a warp feeding operation, the computing unit 115 functions as a part (computing device) of a weaving management apparatus according to the present invention. In the present embodiment, it is defined beforehand that the return length obtained at a time is a length corresponding to the weaving amount for one loom cycle (one weaving step), and the operation of obtaining the return length is repeatedly performed in the process of the warp feeding operation. Moreover, in the present embodiment, the computing unit 115 has a function of subtracting the obtained return from the woven of the tire fabric section stored in the memory 111 each time the return is obtained.

[0077] Detection of the rotation amount of the take-up motor MT during the warp feeding operation is performed by the encoder EN2, which detects the rotation amount of the take-up motor MT to control driving of the take-up motor MT during weaving. Accordingly, during the warp feeding operation, the encoder EN2 also functions as a part (of a detection device (rotation detection device)) of a weaving management apparatus according to the present invention. Moreover, the take-up control device 130 sends the rotation amount signal S2, which represents the rotation amount of the take-up motor MT detected by the encoder EN2, to the main control device 110. Accordingly, during the warp feeding operation, the take-up control device 130 also functions as a part of the weaving management apparatus. The take-up control device 130 outputs the rotation amount signal S2 while the simultaneous backward rotation button is pressed and the velocity command signal from the controller 113 of the main control device 110 is input as described above.

[0078] The tire cord loom 10 according to the present embodiment weaves the fabric sections by driving the heald frames HF in accordance with the plain weaving pattern described above. Moreover, a shedding device, which drives the heald frames HF in this way, is driven by the main shaft MS and causes the heald frames HF to perform predetermined motions in accordance with the rotation of the main shaft MS. As is well known, in the plain weaving pattern, one repeat includes two shedding steps, and one repeat is performed in two loom cycles (two weaving steps).

[0079] In this case, because the warp feeding operation is performed in the state in which the main shaft MS is stopped as described above, the shedding device is also stopped during the warp feeding operation. That is, during the warp feeding operation, the shedding device is in a phase state in one repeat of the shedding pattern at the time at which the loom was sopped when the stopping operation was performed as described above. On the other hand, as a result of the warp feeding operation, the weaving state of the fabric W on the loom (to what extent the fabric W has been woven) changes compared with that at the time at which the loom was stopped. Here, it is assumed that, for example, the two shedding steps of the plain weaving pattern are first and second shedding steps and that the shedding device is in a phase state in which a weft yarn inserted in the second shedding step remains closest to the cloth fell in the state in which the loom was stopped before performing the warp feeding operation. Then, as a result of the weft yarns being extracted for the warp feeding operation as described above, even though the phase state of the shedding device does not change, the weft yarn that remains closest to the cloth fell in the tire fabric section after performing the warp feeding operation may be a weft yearn inserted in the first shedding step.

[0080] If the tire cord loom 10 is restarted in such a state, a warp shed that is first formed after the restart as the shedding device drives the heald frames HF is such that a waft yarn of the tire cord section that remains closest to the cloth fell is exposed to the cloth fell. As a result, another weft yarn is further inserted into the warp shed in which the weft yarn has been already inserted, and a problem arises in that a weaving defect occurs. In the case where the shedding pattern is a plain weaving pattern, such a problem occurs if the number of removed weft yarns is an odd number. Therefore, adjustment may be performed by using the number of weft yarns removed. However, the number of removed weft yarns is not usually checked as described above, such a problem may arise.

[0081] In contrast, in the present embodiment, during the warp feeding operation, the computing unit 115 of the main control device 110 has a function of obtaining the number of weaving steps corresponding to the return length on the basis of the rotation amount of the take-up motor MT that rotates the take-up roller 13a as the movement member described above. As described above, the return length in the present embodiment corresponds to a weaving amount for one weaving step. Accordingly, the number of weaving steps corresponding to the return length is one. That is, in the present embodiment, at each time the return length in the warp feeding operation is obtained, the number of weaving steps (hereinafter, also referred to as "the return step number") corresponding to the of the fabric W that has been returned by the time (the return length/the corresponding to the weaving amount for one weaving step) is obtained. Moreover, in the present embodiment, the computing unit 115 has a function of subtracting one, which is the return step number, from the count value of weaving steps that have been performed to weave the tire fabric section that is being woven, which is stored in the memory 111, each time the return length is obtained.

[0082] With this structure, after performing the warp feeding operation, for example, the count value of weaving steps, which has been reduced as described above, may be displayed on the screen of the input device 19. By doing so, an operator can check on the screen the weaving state of the tire fabric section on the loom after the warp feeding operation, that is, the count value of weaving step that has been performed, which corresponds to the tire fabric section that has been returned. Thus, the operator can easily check whether or not the weaving state of the tire fabric section corresponds to the phase state of the shedding device at the time at which the tire cord loom 10 is restarted. Accordingly, it is possible to prevent an occurrence of a weaving defect as described above.

[0083] Hereinafter, the weaving management apparatus according to the present embodiment will be described in further detail.

[0084] In order to manage the woven length as described above, the memory 111 of the main control device 110 of the loom control apparatus 100 stores the rotation amount of the take-up motor MT for one rotation of the main shaft MS (one weaving step). That is, as described above, during weaving, the take-up roller 13a is rotated by the take-up rotation amount each time the main shaft MS rotates once. The take-up motor MT, which rotates the take-up roller 13a, is driven by the driving rotation amount each time the main shaft MS rotates once (each time the main motor MM rotates by such an amount that that the main shaft MS is rotated once). The take-up rotation amount of the take-up roller 13a is obtained from the set weft density and the diameter of the take-up roller 13a. The driving rotation amount of the take-up motor MT can be obtained from the take-up rotation amount of the take-up roller 13a and the reduction ratio of a transmission mechanism that transmits the rotation of the take-up motor M to the take-up roller 13a. The driving rotation amount, which is obtained in this way, is stored in the memory 111.

[0085] As a component of the weaving management apparatus, the main control device 110 includes a comparator 117 that compares the driving rotation amount stored in the memory 111 with the rotation amount of the take-up motor MT during a warp feeding operation. The comparator 117 is connected to the memory 111 and the take-up control device 130, and is also connected to the computing unit 115. The comparator 117 compares the rotation amount signal S2, which represents the rotation amount of the take-up motor MT and which is output from the take-up control device 130 during the warp feeding operation, with the driving rotation amount stored in the memory 111. On the basis of the comparison result, the comparator 117 outputs an imaginary main shaft rotation signal. Accordingly, in the present embodiment, the driving rotation amount of the take-up motor MT corresponds to a unit movement amount in the present invention. A structure related to the comparison operation performed by the comparator 117 may be, for example, as follows.

[0086] First, the rotation amount signal S2, which is output from the take-up control device 130 to the comparator 117, is a pulse row signal including continuous pulses each representing a unit rotation amount of the take-up motor MT. As the rotation amount signal S2 is input, the comparator 117 successively counts the number of pulses included in the rotation amount signal S2. The driving rotation amount, which is stored in the memory 111, is set as a set value (set pulse number) that corresponds to the driving rotation amount when the unit rotation amount is regarded as one pulse.

[0087] The comparator 117 successively compares the count value of the pulse number based on the rotation amount signal S2 with the set pulse number stored in the memory 111. At a time at which the count value coincides with the set pulse number, the comparator 117 outputs the imaginary main shaft rotation signal RS to the computing unit 115. At the time at which the comparator 117 outputs the imaginary main shaft rotation signal RS, the comparator 117 resets the count value and starts counting again from one as the rotation amount signal S2 is input subsequently. Thus, during the warp feeding operation, each time the take-up motor MT is rotated backward by the driving rotation amount (each time the take-up roller 13a is rotated by the take-up rotation amount), that is, each time the fabric W for one weaving step is returned due to the warp feeding operation, the comparator 117 outputs the imaginary main shaft rotation signal RS.

[0088] In this case, the count value of the pulse number obtained by the comparator 117 is a detected movement amount (detected rotation amount). Accordingly, in the case of this example, the comparator 117 also functions as a part of a detection device (rotation detection device) of a weaving management apparatus according to the present invention. That is, in the present embodiment, the rotation detection device, as a detection device, is constituted by the encoder EN2, which detects the rotation amount of the take-up motor MT and outputs the rotation amount signal S2, and the comparator 117, which obtains the detected rotation amount on the basis of the rotation amount signal S2.

[0089] Each time the imaginary main shaft rotation signal RS is input from the comparator 117, the computing unit 115 determines that the fabric W (tire fabric section) for one weaving step has been returned. In other words, at a time at which the computing unit 115 receives the imaginary main shaft rotation signal RS, which is output from the comparator 117 on the basis of the rotation amount of the take-up motor MT (the take-up roller 13a) detected by the encoder EN2 (detected rotation amount as a detected movement amount), the computing unit 115 enters a state in which the computing unit 115 recognizes that the length of the fabric W returned by the time during the warp feeding operation has become a weaving amount for one weaving step, which is the woven length in the present embodiment (a state in which the computing unit 115 has obtained a weaving amount for one weaving step as the return length). In accordance with the determination, the computing unit 115 performs subtraction of the return length obtained from the set weft density (weaving amount for one weaving step) of the tire fabric section stored in the memory 111 from the woven of the tire fabric section stored in the memory 111.

[0090] As described above, the take-up control device 130 continuously outputs the rotation amount signal S2 to the comparator 117 while the simultaneous backward rotation button is pressed, that is, while the warp feeding operation is being performed. The comparator 117 repeatedly performs the comparison operation while the rotation amount signal S2 is being input, and outputs the imaginary main shaft rotation signal RS on the basis of the comparison result. During the warp feeding operation, the computing unit 115 repeatedly subtracts the return length from the woven length stored in the memory 111 each time the imaginary main shaft rotation signal RS is generated (each time the fabric W is returned by a length corresponding to a weaving amount for one weaving step). Thus, at a time at which the warp feeding operation is finished, the woven length stored in the memory 111 coincides with the actual woven length as a result of returning the fabric W due to the warp feeding operation. Accordingly, even when the warp feeding operation is performed while the main shaft MS is stopped, the woven length stored in the memory 111 coincides with the actual woven length of the fabric W at a time at which the tire cord loom 10 is restarted. Therefore, the woven length of the fabric W can be managed without causing a problem.

[0091] The computing unit 115 subtracts one, which is the return step number, from the count value of weaving steps stored in the memory 111 as described above, each time it is detected that the take-up motor MT is rotated backward by the driving rotation amount and the imaginary main shaft rotation signal RS is output from the comparator 117, that is, each time the fabric W is returned by a weaving amount for one weaving step (= the return length). That is, at a time at which the imaginary main shaft rotation signal RS is input, the computing unit 115 enters a state in which the computing unit 115 has obtained the number of weaving steps corresponding to the length of the fabric W that has been returned at the time. Accordingly, the computing unit 115 performs subtraction of one, which is the return step number, from the count value of weaving steps stored in the memory 111. Thus, the count value of weaving steps stored in the memory 111 at a time at which the warp feeding operation is finished coincides with the weaving state of the tire fabric section of the fabric W returned due to the warp feeding operation.

[0092] For example, by displaying the count value of weaving steps stored in the memory 111 on the screen of the input device 19, an operator can check on the screen the weaving state of the tire fabric section of the fabric W returned due to the warp feeding operation. Accordingly, at a time before restarting the tire cord loom 10, the operator can determine whether or not the weaving state of the tire fabric section of the fabric W on the loom corresponds to the phase state of the shedding device at the time. In other words, the operator can determine whether or not a shedding step of the plain weaving pattern that is first performed after the restart differs from a shedding step in which a waft yarn that remains at a position closest to the cloth fell was inserted.

[0093] Thus, for example, if it is determined that these shedding steps are the same, an occurrence of a weaving defect as described above can be prevented by performing an operation of returning the fabric W further by the amount for one weaving cycle and making the shedding steps differ from each other. That is, it is possible to provide the operator with information for preventing the weaving defect by making the count value of the weaving step stored in the memory 111 coincide with the weaving state of the tire fabric section of the fabric W returned due to the warp feeding operation and by enabling the operator to check the count value.

[0094] Heretofore, an embodiment of the present invention has been described. However, the present invention is not limited to the embodiment and may be carried out in the following modified embodiments.

(1) In the embodiment described above, it is assumed that the take-up roller 13a of the take-up mechanism 13 is a movement member (a member that moves as the warp row moves during the warp feeding operation) in the present invention, and the movement amount of the movement member is detected by detecting the rotation amount of the take-up motor MT, which rotates the take-up roller 13a. However, the present invention is not limited to such an embodiment. For example, even when the take-up roller 13a is used as the movement member, instead of detecting the movement amount of the movement member by detecting the rotation amount of the take-up motor MT, the rotation amount of the take-up roller 13a may be directly detected. That is, a rotation detection device, which is a detection device for detecting the rotation amount of the take-up roller 13a, may be additionally provided, and the rotation detection device may obtain a detected rotation amount as a detected movement amount. In this case, the comparator 117 compares the take-up rotation amount of the take-up roller 13a with the detected rotation amount obtained by the rotation detection device, and the take-up rotation amount of the take-up roller 13a is stored in the memory unit (the memory 111).

[0095] Regarding a movement member, it may be assumed that the let-off roller 11 a of the let-off mechanism 11, which is rotated backward simultaneously with the take-up mechanism 13 during the warp feeding operation, is the movement member. In this case, the movement amount of the movement member may be detected by detecting the rotation amount of the let-off motor ML by using the encoder EN3, or as in the case of the take-up roller 13a, the rotation amount of the let-off roller 11 a may be directly detected. Moreover, the movement member is not limited to the take-up roller 13a or the let-off roller 11 a as described above. The movement member may be the press roller 13b (or 13c), which is rotated by the take-up roller 13a in the take-up mechanism 13; the nip roller 11 b, which is rotated by the let-off roller 11 a in the let-off mechanism 11; or any of other rollers (such as the guide roller 15a and the guide roller 17b) that are rotated as the warp row T or the fabric W moves. In a case where any of these rollers is used as the movement member, a rotation detection device that detects the rotation amount of the movement member is additionally provided as a detection device.

[0096] Furthermore, the movement member is not limited to one of existing rollers of the tire cord loom 10 and may be a dedicated member for the weaving management apparatus according to the present invention. For example, a pair of rollers may be provided between the tension roller 15b and the heald frames HF so as to nip some of the warp yarns t of the warp row T in the vertical direction. The pair of rollers are rotatably supported, and are rotated as the warp yarns t move. In this case, one of the pair of rollers may be used as a movement member according to the present invention, and the rotation amount of the roller may be detected by a rotation detector. The pair of rollers may be disposed so as to nip the warp yarns t regardless of whether weaving is performed or the loom is stopped, or the pair of rollers may be separated from each other during weaving and may nip the warp yarns t only during the warp feeding operation.

[0097] As described above, in the present invention, one of a plurality of rollers (rotation members) that are included in the tire cord loom 10 and that rotate as the warp row T and the fabric W move during the warp feeding operation may be set as a movement member. When setting one of the rotation members other than the take-up roller 13a as the movement member, the rotation amount of the rotation member for one weaving step (one rotation of the main shaft MS) during weaving is obtained beforehand and stored in the memory unit, and the comparator compares the rotation amount stored in the memory with the detected rotation amount detected by the rotation detector.

[0098] A movement member according to the present invention is not limited the rotation member that rotates as the warp row T (the fabric W) moves as described above. For example, the fabric W or the warp yarns t of the warp row T may be set as the movement member. To be specific, a detector (sliding sensor) that is disposed in contact with the fabric W or the warp yarns t and that detects a movement of the fabric W or the warp yarns t may be provided, and a time (movement time) during which the warp row T (the fabric W) moves during the warp feeding operation is detected. In this case, from the movement velocity of the warp row T (the fabric W) obtained beforehand and the movement time, the movement amount of the warp row T (the fabric W) during the warp feeding operation, that is, the length of the fabric W returned due to the warp feeding operation may be obtained.

(2) In the embodiment described above, the return length obtained by the computing unit 115, which is an example of a computing device, is a length corresponding to a weaving amount for one loom cycle (for one weaving step); during the warp feeding operation, a time at which the fabric W for this length is returned (a time at which the length of the returned fabric W reaches the length corresponding to the weaving amount for one weaving step, which is the return length) is obtained: and the weaving amount for one weaving step is subtracted from the woven length stored in the memory 111 at the time. However, the present invention is not limited to such an embodiment and may be, for example, as follows.

[0099] First, regarding detection of the movement amount of the movement member (the rotation amount of the take-up roller 13a in the case of the embodiment), the movement amount of the movement member throughout the period from the start to the end of the warp feeding operation is detected. The computing device obtains the total length of the area of the fabric W (the return area) returned due to the warp feeding operation, which is the return length, from the movement amount detected (detected movement amount) and from the movement amount of the movement member for one weaving step and the weaving amount for one weaving step, which are stored in the memory unit. In this case, the computing device may subtract the obtained length of the entirety of the return area (the return length) from the woven length stored in the memory unit after the warp feeding operation.

[0100] In this case, the subtraction of the return length from the woven length stored in the memory unit may be automatically performed by the computing device (the computing unit 115) as in the embodiment described above. However, an operator may perform the subtraction. That is, the computing device only obtains the return length, and the obtained return length is displayed on the screen of the input device 19. Then, the operator may see the display and perform the subtraction by operating the input device 19. Thus, in a weaving management apparatus according to the present invention, the computing device is not limited to a device having a function of performing the subtraction, and may have only the function of obtaining the return length regarding the present invention.

[0101] At predetermined intervals, the computing device may perform an operation of obtaining the length of the fabric W returned in the interval; and, each time this operation is performed, the computing device may subtract the obtained return length from the woven length stored in the memory unit. Regarding the warp feeding operation, in a case where the return area of the fabric W is not returned with a single operation but is returned with a plurality of operations and where the movement of the warp row T (pressing of the simultaneous backward rotation button by an operator) in each operation is performed in an arbitrary time, the length of the fabric W returned in each operation may be obtained as the return length each time the operation is performed.

[0102] In the case of these examples, the comparator for outputting the imaginary main shaft rotation signal RS, which is included in the embodiment, is not necessary. Instead, a movement amount detector that obtains the detected movement amount on the basis of a detection signal (the rotation amount signal S2 in the case of the embodiment) from a detector that detects the movement amount of the movement member (the encoder EN2 that detects the rotation amount of the take-up roller 13a in the case of the embodiment) may be provided. In this case, at a time at which the return length is obtained as described above, the movement amount detector may output the detected movement amount to the computing device. The computing device or the take-up control device 130 may have a function corresponding to the function of the movement amount detector.

(3) In the embodiment described above, during the

warp feeding operation, each time the fabric W having a length corresponding to a weaving amount for one weaving step is returned, one, which is the number of weaving steps, is subtracted from the count value of the weaving steps stored in the memory 111. That is, in the embodiment, each time the predetermined return length is obtained, the number of weaving steps corresponding to the return length is subtracted from the count value of the weaving steps stored in the memory unit. However, in the present invention, it is not necessary to subtract the return step number from the count value of the weaving steps stored in the memory unit. For example, if it is possible to determine whether or not the weaving state of the fabric W and the phase state of the shedding device on the loom correspond to each other, the computing device need not have the function of obtaining the return step number and the function of performing subtraction of the return step number.

[0103] In the case where the computing device has the function of obtaining the return step number, it is not necessary that the computing device obtain the return step number in the same way as in the embodiment. For example, in the case of obtaining, at predetermined intervals, the length of the fabric W returned in the interval as described above, the computing device may obtain the number of weaving steps corresponding to the return length as the return step number each time the return length is obtained. Then, the computing device may subtract the obtained return step number from the count value of the weaving steps stored in the memory unit.

[0104] Regarding a method of obtaining the return step number, from the length of the return area, which is the entire area of the fabric W that is returned due to the warp feeding operation, the computing device may simultaneously obtain the number of weaving steps corresponding to the length of the return area at a time at which the warp feeding operation is finished. In this case, it is not necessary that the computing device perform the subtraction of the obtained return step number. Instead of the count value of weaving steps, which is the result of the subtraction, the obtained return length may be displayed on the screen of the input device 19. In this case, the operator may see the display and perform the subtraction by operating the input device 19. The subtraction itself may be omitted in a case where it is possible to check the correspondence between the weaving state of the fabric W and the phase state of the shedding device after the warp feeding operation by only displaying the return step number and where a problem does not occur even if the count value of the weaving steps stored in the memory unit does not coincide with the number of weaving steps that have been performed on the fabric W after the warp feeding operation.

(4) In the embodiment described above, the memory 111, which stores weaving conditions for weaving and the like, also functions as a memory unit of a weaving management apparatus according to the present invention. However, regarding the memory unit, for example, the loom control apparatus 100 (the main control device 110) may include, in addition to a memory that stores setting values of weaving conditions for weaving and the like, another memory that stores the woven length and the count value of weaving steps, and the other memory may function as the memory unit. The woven length and the count value of weaving steps may be stored in different memories, and the two memories may constitute the memory unit in the present invention.

[0105] In the embodiment described above, the comparator 117 counts the pulse number of a rotation amount signal, which is a pulse row signal, and thereby the detected rotation amount (detected movement amount) is obtained. Alternatively, a counter may be provided between the comparator 117 and the take-up control device 130, and the counter may count the pulse number and output the count value to the comparator 117 each time a pulse in the pulse row signal is input. In this case, the counter and the encoder EN2 constitute the rotation amount detection device. The take-up control device 130 may have a function corresponding to the function of the counter.

[0106] In the embodiment described above, the comparator 117 resets the count value each time the imaginary main shaft rotation signal RS is output. However, instead of resetting the count value, the pulse number may be counted continuously throughout the warp feeding operation. In this case, each time the count value increases by the set pulse number, it may be determined that the count value has increased, and the imaginary main shaft rotation signal RS may be output each time the determination is made. In this case, a time at which it is determined that the detected movement amount has increased by a unit movement amount corresponds to a time at which the detected movement amount coincides with the unit movement amount according to the present invention.

[0107] In the embodiment described above, the rotation amount signal S2, which is output from the encoder EN2 that detects the rotation amount of the take-up motor MT (the take-up roller 13a as a movement member) is a pulse row signal; and the detected rotation amount is the count value of the pulse number. However, in the present invention, the detected movement amount (detected rotation amount) detected by the detection device (rotation detection device) is not limited to such a count value of the pulse number and may be the absolute value of the movement amount (rotation amount). That is, the detection device (rotation detection device) may detect the absolute value of the movement amount of the movement member.

[0108] The present invention is not limited to any of the embodiments described above and may be modified in various ways within the spirit and scope of the present invention.

Claims

1. A weaving management method for a tire cord fabric weaving loom (10) that weaves a tire cord fabric (W) including a tire fabric section, that successively obtains a weaving amount of the tire cord fabric (W) on the basis of a rotation amount of a loom main shaft (MS) during weaving, and that stores the weaving amount of the tire cord fabric (W) that has been woven as a woven length, the method comprising:

   detecting a movement amount of a movement member, which moves as a warp row (T) moves, in a process of a warp feeding operation that is performed by moving the warp row (T) toward a let-off mechanism (11) in a state in which rotation of the loom main shaft (MS) is stopped while the loom is stopped;
   obtaining a return length of the tire cord fabric (W) that has been returned due to the warp feeding operation on the basis of the detected movement amount; and
   subtracting the obtained return length from the stored woven length.

2. The weaving management method according to Claim 1,
   wherein the movement member is a take-up roller (13a) of a take-up mechanism (13), over which the tire cord fabric (W) that has been woven is looped and which is rotated by a take-up motor (MT),
   wherein a rotation amount of the take-up roller (13a), which is rotated backward when the warp row (T) moves, is detected, and
   wherein the return length is obtained on the basis of the detected rotation amount as the detected movement amount.

3. The weaving management method according to Claim 1 or 2,
   wherein the tire cord fabric weaving loom (10) regards one loom cycle corresponding to one rotation of the loom main shaft (MS) as one step of weaving, counts the steps successively as weaving progresses, and stores a count value of the steps,
   wherein the number of the steps corresponding to the return of the tire cord fabric (W) that has been returned due to the warp feeding operation is obtained on the basis of the detected movement amount, and
   wherein the obtained number of the steps is subtracted from the stored count value.

4. The weaving management method according to Claim 3,
   wherein an imaginary main shaft rotation signal (RS) is output each time the detected movement amount coincides with a unit movement amount that is a movement amount of the movement member in the one step during weaving, and
   wherein, each time the imaginary main shaft rotation signal (RS) is output, a weaving amount for the one step is subtracted as the return length from the stored woven length and one is subtracted from the stored count value as the number of the steps.

5. A weaving management apparatus for a tire cord fabric weaving loom (10) that weaves a tire cord fabric (W) including a tire fabric section and that includes a loom control apparatus (100) including a memory unit that stores a weaving amount of the tire cord fabric (W) that is being woven as a woven length, the weaving amount being obtained on the basis of a rotation amount of a loom main shaft (MS), the loom control apparatus (100) causing a take-up mechanism (13) and a let-off mechanism (11) to rotate backward while the loom is stopped to perform a warp feeding operation with which a warp row (T) is moved toward the let-off mechanism (11) in a state in which rotation of the loom main shaft (MS) is stopped, the weaving management apparatus comprising:

   a detection device that detects a movement amount of a movement member, which moves as the warp row (T) moves, during the warp feeding operation; and
   a computing device (115) that obtains a return length of the tire cord fabric (W) that has been returned due to the warp feeding operation on the basis of a detected movement amount that is the movement amount of the movement member detected by the detection device.

6. The weaving management apparatus according to Claim 5,
   wherein the movement member is a take-up roller (13a) of the take-up mechanism (13), over which the tire cord fabric (W) that has been woven is looped and which is rotated by a take-up motor (MT),
   wherein the detection device is a rotation detection device that detects a rotation amount of the take-up roller (13a), and
   wherein the computing device (115) obtains the return length on the basis of the detected rotation amount that is detected by the rotation detection device as the detected movement amount.

7. The weaving management apparatus according to Claim 5 or 6,
   wherein the tire cord fabric weaving loom (10) regards one loom cycle corresponding to one rotation

of the loom main shaft (MS) as one step of weaving, the loom control apparatus (100) counts the steps successively as weaving progresses and stores a count value of the steps in the memory unit, and wherein the computing device (115) has a function of obtaining the number of steps corresponding to the return length of the tire cord fabric (W) that has been returned due to the warp feeding operation on the basis of the detected movement amount.

8. The weaving management apparatus according to Claim 7, wherein a movement amount of the movement member in the one step is stored as a unit movement amount in the memory unit, wherein the weaving management apparatus comprises a comparator (117) that compares the detected movement amount with the unit movement amount during the warp feeding operation and that outputs an imaginary main shaft rotation signal (RS) to the computing device (115) each time the detected movement amount coincides with the unit movement amount, and wherein the computing device (115) has a function of subtracting a weaving amount for the one step as the return length from the woven length stored in the memory unit and subtracting one as the number of steps from the count value of the steps stored in the memory unit each time the comparator (117) outputs the imaginary main shaft rotation signal (RS).

FIG. 1

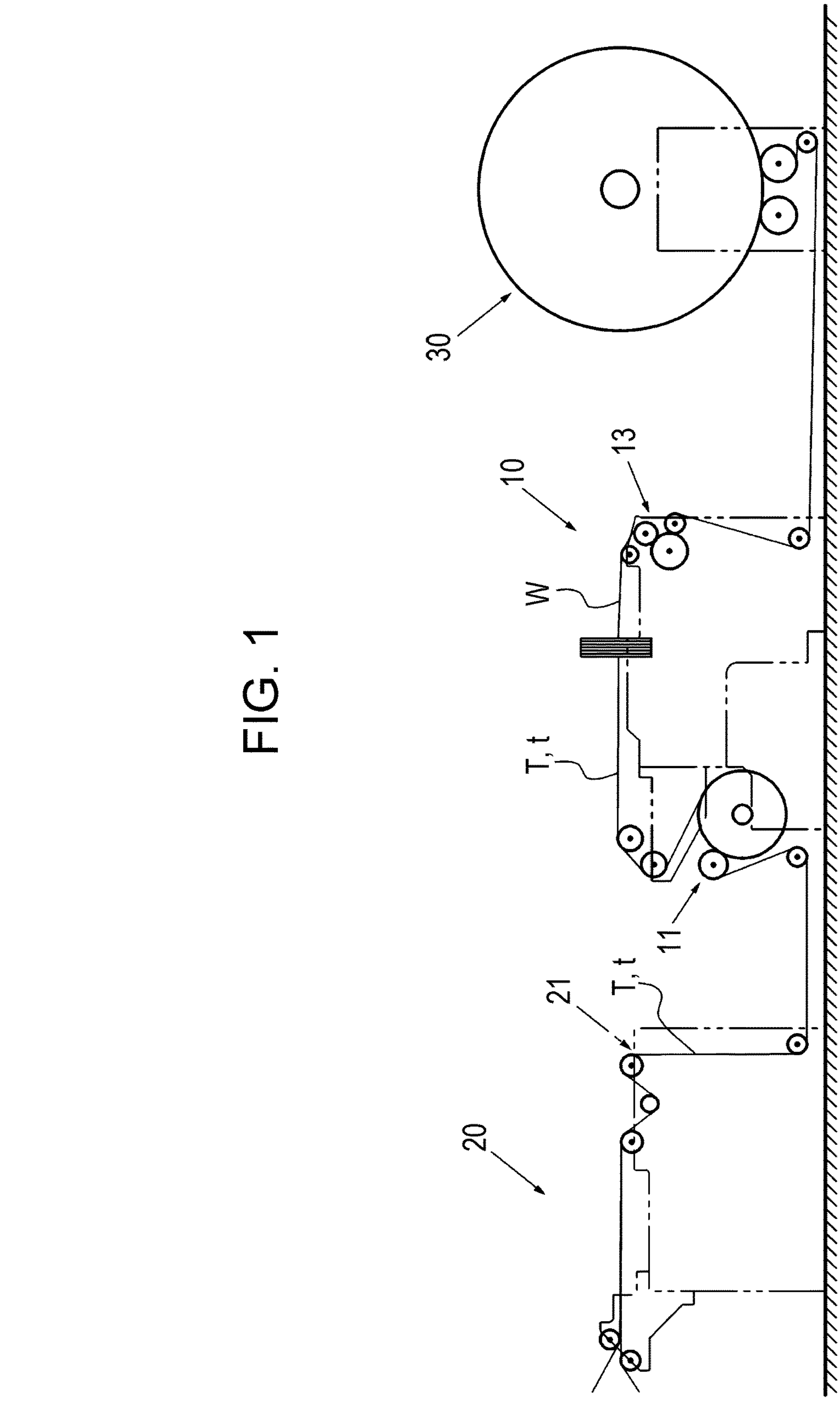


FIG. 2

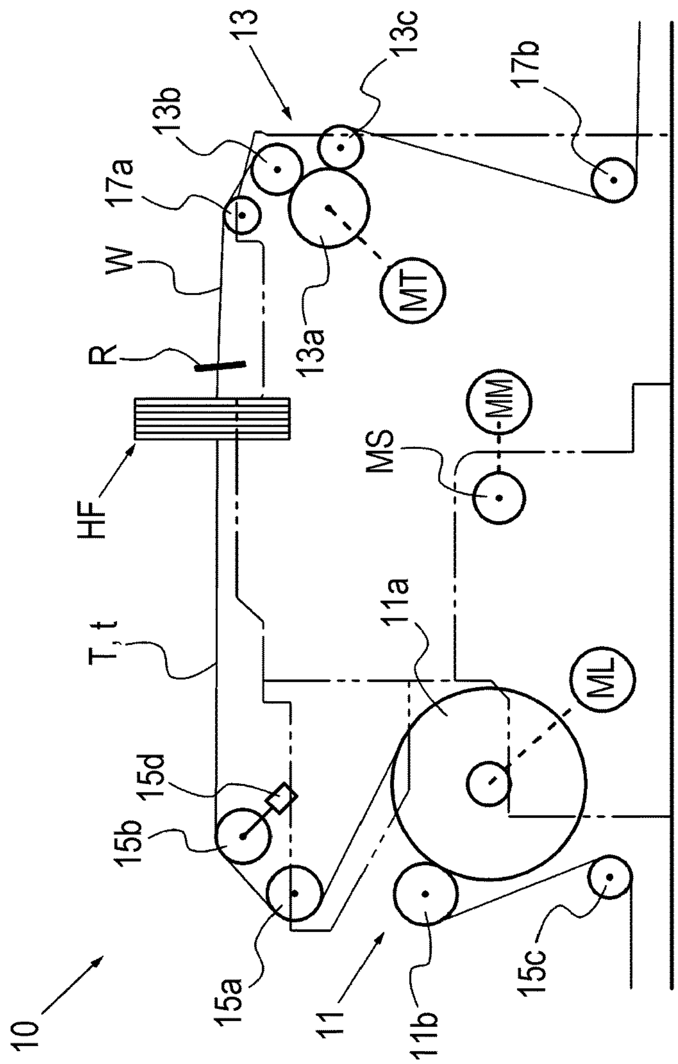
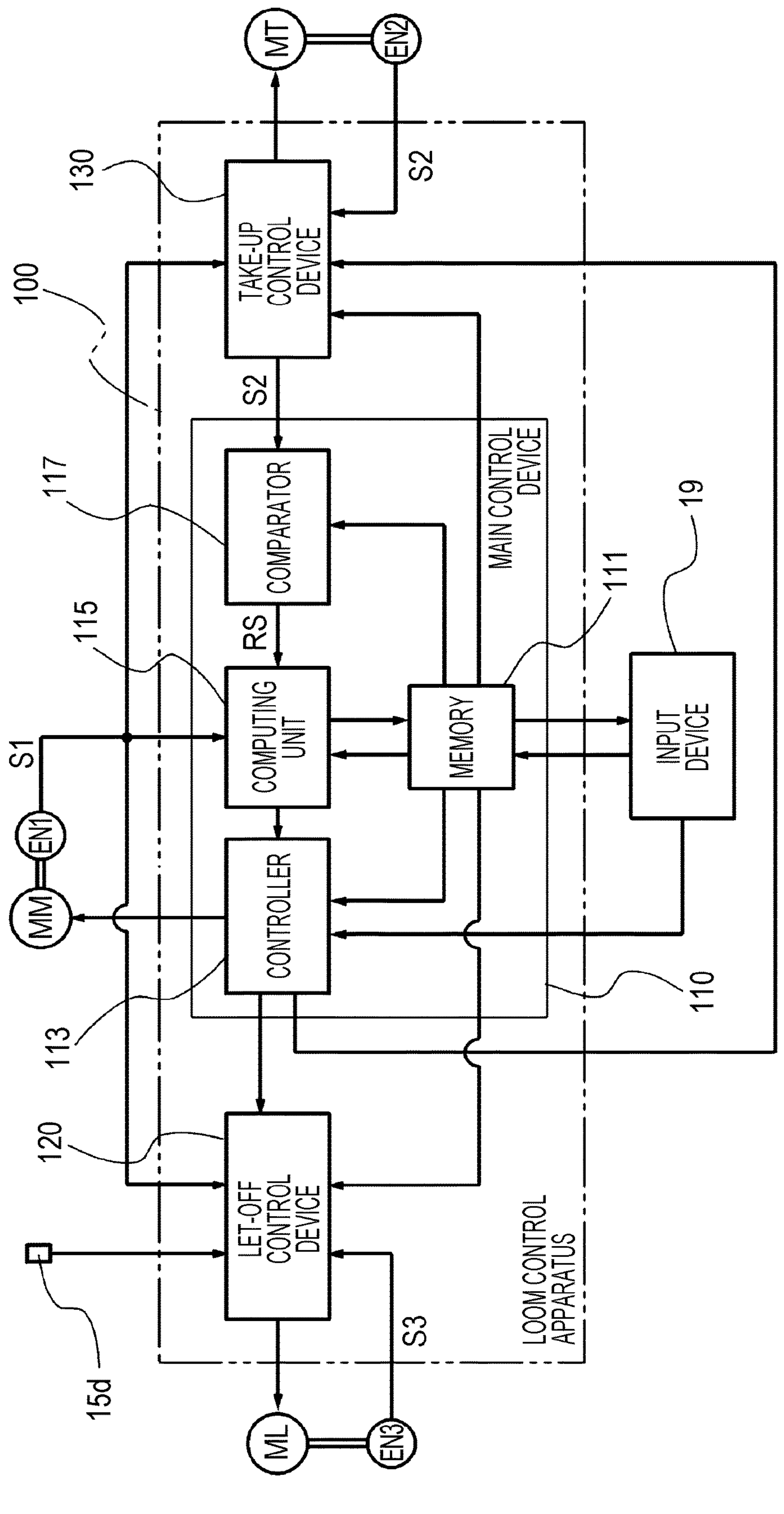

10
11
11a
11b
13
13a
13b
13c
15a
15b
15c
15d
17a
17b
W
R
HF
T, t
MT
MS
MM
ML

FIG. 3


MT
EN2
S2
130
TAKE-UP CONTROL DEVICE
100
S2
117
COMPARATOR
MAIN CONTROL DEVICE
19
111
115
RS
COMPUTING UNIT
MEMORY
INPUT DEVICE
S1
EN1
MM
CONTROLLER
113
110
120
LET-OFF CONTROL DEVICE
15d
S3
LOOM CONTROL APPARATUS
ML
EN3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0976

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 405 042 A2 (TSUDAKOMA IND CO LTD [JP]) 11 January 2012 (2012-01-11) * paragraph [0059] - paragraph [0063] * -----	1-8	INV. D03D51/00 D03D49/20 D03D49/10 D03J1/20
A,D	JP 2012 149365 A (TSUDAKOMA IND CO LTD) 9 August 2012 (2012-08-09) * abstract *	1-8	
A	& EP 2 479 326 A2 (TSUDAKOMA CORP) 25 July 2012 (2012-07-25) * paragraph [0056] - paragraph [0058] * -----	1-8	
A	EP 0 184 779 A2 (ERGOTRON DONDI BENELLI DORE [IT]) 18 June 1986 (1986-06-18) * page 2, line 7 - line 25 * * page 14, line 1 - page 19, line 2 * -----	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D D03J

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	1 February 2017	Hausding, Jan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 18 0976

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-02-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2405042 A2	11-01-2012	CN 102312337 A	11-01-2012
		EP 2405042 A2	11-01-2012
		JP 5520717 B2	11-06-2014
		JP 2012017532 A	26-01-2012
JP 2012149365 A	09-08-2012	CN 102605518 A	25-07-2012
		EP 2479326 A2	25-07-2012
		JP 5909042 B2	26-04-2016
		JP 2012149365 A	09-08-2012
EP 0184779 A2	18-06-1986	DE 3579127 D1	13-09-1990
		EP 0184779 A2	18-06-1986
		IT 1179857 B	16-09-1987

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2012149365 A **[0004]**
- JP 2011111700 A **[0008]**