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

(11) EP 1 864 931 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.12.2007 Bulletin 2007/50

(51) Int Cl.:
B65H 54/26 *(2006.01)* ***D01H 13/00*** *(2006.01)*

(21) Application number: **07009247.3**

(22) Date of filing: **08.05.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **16.05.2006 JP 2006137060**

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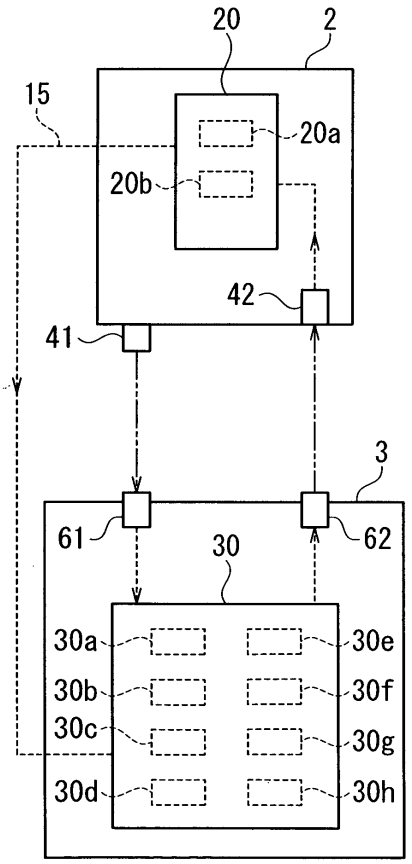
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(54) Textile machine having doffing device

(57) A problem with the conventional art is that in setting a target for a doffing operation, an attempt to reduce burdens on a traveling controlling mechanism of a doffing device may reduce the operational efficiency of winding units. The present invention provides a winding state recognizing means 30b for recognizing the winding length of a package 7 in each of winding units 2 to be longer or shorter, a target setting means 30c for setting the winding unit on which a doffing operation is to be executed by giving top priority to those winding units 2 which have a winding length corresponding to a full package and giving the second priority to winding units 2 with near full packages, and an operation standby means 3Qd for causing a doffing device 3 to stand by without performing a doffing operation after the doffing device 3 reaches the winding unit 2 on which a doffing operation is to be executed and until the package 7 being formed in the winding unit 2 becomes full (Fig. 5A, 5B).

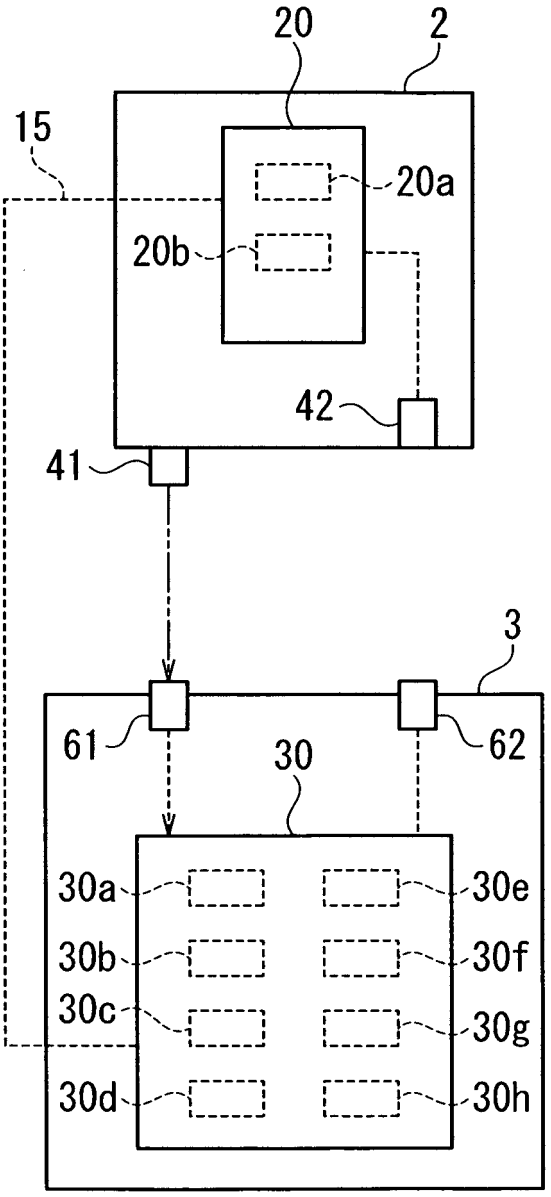
Fig. 5A



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Fig. 5B



Description

Field of the Invention

[0001] The present invention relates to a textile machine comprising a plurality of winding units each of which winds a yarn around a winding tube to form a package and a doffing device that stops at an operation position provided for each of the winding units to execute a doffing operation on the winding unit corresponding to that operation position.

Background of the Invention

[0002] Textile machines have been known which comprise a plurality of winding units arranged in a line and a doffing device that travels along the line of the winding units to execute a doffing operation on any one of the winding units.

[0003] The Unexamined Japanese Patent Application Publication (Tokkai-Sho) No. 64-34875 (hereinafter referred to as "Japanese Patent Application Publication") discloses a method for controlling traveling of a doffing device in such a textile machine (winder) as described above. According to this method, a full package unit (a winding unit having a full package) is found so that the doffing device can efficiently execute a doffing operation on this full pachage (winding) unit.

[0004] In this case, the time when a package in each winding unit becomes full is almost the same during a short period after the start of operation of the winder, but varies as the time elapses after the start of operation. As a result, the winding units randomly produce full packages. To respond to the situation where winding units randomly produce full packages so that efficient doffing operations are achieved, the method for controlling traveling in accordance with the Japanese Patent Application Publication compares a full package unit with the next full package unit expected to subsequently produce a full package to set a target winding unit to which the doffing device is to travel (the winding unit on which a doffing operation is to be executed). The traveling target is set so as to allow an efficient doffing operation to be achieved, using, as determination materials, the distances (11, 12) from the doffing device to the full package unit and to the next full package unit, the time (T1) required by the doffing device to travel to the full package unit, the time (TF) required by the next full package unit to complete a full package, and the like. Claims of the Japanese Patent Application Publication describe determination conditions including combinations of these distances and times. The above reference numerals and characters in the parentheses belong to the Japanese Patent Application Publication.

[0005] The method for controlling traveling in accordance with the Japanese Patent Application Publication sets the next target to which the doffing device is to move (the next target on which a doffing operation is to be executed) utilizing results determined for both a full package unit and the next expected full package unit based on determination conditions including combinations of information on the distances and times. This increases the time required for the determining process, making it difficult to control traveling to the traveling target. In other cases, an increase occurs in the cost of a control mechanism required to control traveling of the doffing device. On the other hand, when the method for controlling traveling in accordance with the Japanese Patent Application publication is not used, and the doffing device is simply controlled as follows: Only if any one of the winding units completes a full package, the doffing device travels to this winding unit. This would reduce not only the efficiency of a doffing operation but also the operational efficiency of the winding units.

[0006] That is, problems to be solved by the present invention is that in setting a target for a doffing operation, an attempt to reduce burdens on the traveling control mechanism of the doffing device disadvantageously reduces the operational efficiency of the winding units.

Summary of the Invention

[0007] A description has been given of the problems to be solved by the present invention. Now, the description will be given of means for solving the problems.

[0008] According to Claim 1, a textile machine comprises a plurality of winding units each of which winds a yarn around a winding tube to form a package and a doffing device that moves to one of the winding units to execute a doffing operation on the winding unit, and

the textile machine further comprises a target setting means for setting the winding unit on which the doffing operation is to be executed by giving top priority to those winding units which have a winding length corresponding to a full package and setting priorities for winding units with less full packages - near full packages- so that a higher priority is given to a winding unit having a winding length nearer to a full package, and

an operation standby means for causing the doffing device to stand by without performing the doffing operation after the doffing device reaches the execution target winding unit and until the package being formed in the winding unit becomes full.

[0009] This configuration has the following operations.

[0010] When a plurality of winding units have a near full package, the order in which a doffing operation is executed on these winding units is set equal to the order of a winding length corresponding to a nearer full package.

[0011] After reaching a winding unit with a near full package, the doffing device stands by until the winding unit completes a full package.

[0012] Claim 2 sets forth the textile machine having the doffing device according to Claim 1 which is further configured as follows.

[0013] The textile machine comprises a predetermined

length signal transmitting means for, when the winding length of the package reaches a predetermined value smaller than the value for a full package, allowing the winding unit forming that package to transmit a predetermined length reach signal, and
the target setting means determines the winding length of the package in each of the winding units to be longer or shorter, which longer or shorter length of the package is recognized on the basis of a transmission time at which each of the winding units transmits the predetermined length reach signal.

[0014] This configuration has the following operation.

[0015] An arrangement for recognition of the winding length is simplified.

[0016] Claim 3 sets forth the textile machine having the doffing device according to Claim 1 or Claim 2 which is further configured as follows.

[0017] Where a plurality of the winding units have a winding length of the package corresponding to a full package, the target setting means sets the execution target in order of shorter distance from the current position of the doffing device to the winding unit.

[0018] This configuration has the following operation.

[0019] Even when a plurality of winding units are recognized to have the same winding state, doffing operations can be prioritized.

[0020] The present invention exerts the following effects.

[0021] In Claim 1, even when a plurality of winding units have near full packages, the order of execution of a doffing operation among these winding units is set equal to the order in which the packages in these winding units become full. This makes it possible to prevent a decrease in the operational efficiency of the winding units. Further, the order of execution is set on the basis only of differences in winding length. This prevents an increase in burdens on the traveling control mechanism of the doffing device.

[0022] In addition to exerting the effect of Claim 1, Claim 2 simplifies the arrangement for recognition of the winding length. This is economically advantageous.

[0023] In addition to exerting the effect of Claim 1 or Claim 2, Claim 3 enhances the prevention of a decrease in operational efficiency of the winding units without increasing burdens on the traveling control mechanism of the doffing device.

[0024] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

Brief Description of the Drawings

[0025]

Figure 1 is a front view showing the construction of a winder.

Figure 2 is a side sectional view of the winder.

Figure 3 is a schematic plan view showing the construction of the winder.

Figure 4 is a diagram showing that a plurality of winding units in the winder have a full package or a near full package.

Figure 5 is a block diagram showing a configuration of a current position detecting means.

Figure 6 is a flowchart of a doffing operation executed by a doffing device.

Detailed Description of the Preferred Embodiments

[0026] An embodiment of the present invention will be described with reference to the drawings.

[0027] With reference to Figure 1, a description will be given of a winder 1 in accordance with an embodiment of the present invention.

[0028] The winder 1 is an apparatus that rewind a yarn from a supplying bobbin 6 with a package of a material yarn to form a package 7.

[0029] The winder 1 comprises a plurality of winding units arranged along one direction, a doffing device 3 that is movable along a line of the winding units 2, and an air supply section 4 and a main body control section 5 arranged at one end of the line of the winding units 2.

[0030] The winding unit 2 as used herein refers to a unit (an aggregate of devices) for forming one package 7 around one winding tube 10. The winder 1 can form packages 7 in parallel in accordance with the arrangement number which is the same as that of the winding units 2 provided in the winder 1.

[0031] The doffing device 3 moves to any one of the winding units to execute a doffing operation on that winding unit.

[0032] Figure 2 is a sectional view (side sectional view) of the winder 1 as viewed from a direction in which the winding units 2 are arranged, and Figure 2 shows the winding unit 2 and the doffing device 3.

[0033] A main frame 11 is protrusively located along the direction in which the winding units 2 are arranged. The main frame 11 supports unit frames 21 each of which supports the devices constituting the winding unit 2 and rails 12 along which the doffing device 3 travels.

[0034] As shown in Figure 2, the winding unit 2 comprises the unit frame 21 and devices relating to a rewinding operation which are supported by the unit frame 21.

[0035] The devices relating to a rewinding operation include a tension device 23, a yarn defect detecting device 24, a yarn splicing device 25, a winding device 26 that forms a package 7. The devices 23 to 26 are arranged in the above order from below to above. The supplying bobbin 6 is set below the tension device 23. The winding unit 2 also comprises a unit controller 20 (Figure 1) that drivingly controls the devices 23 to 26.

[0036] The winding device 26 comprises a cradle 27 that supports a winding tube 10 around which the package 7 is formed and a traversing drum 28 that is rotated

in contact with the winding tube 10 or package 7.

[0037] Each of the wining units 2 comprises a winding tube stocker 29 in which a supplementary winding tube 10 is stored. When a winding preparing operation such as setting of the winding tube 10 is completed, the winding unit 2 automatically forms a package 7 around the winding tube 10.

[0038] A package receiver 13 is also provided for each winding unit 2 to receive a full package 7 unloaded from the cradle 27.

[0039] As shown in Figure 2, the doffing device 3 comprises a vehicle frame 31, a traveling device 32 that travels along the rails 12, and a device relating to a doffing operation.

[0040] Here, the doffing operation means a total operation including an operation for unloading a full package from the winding unit 2, an operation for setting the winding tube 10 in which a required empty winding tube 10 is newly supplied in response to unloading of the full package 7, and a yarn capturing operation for capturing a yarn on the set winding tube 10 to make the winding tube 10 ready for winding.

[0041] As a device relating to a doffing operation, the device comprises a cradle opener 33 relating to an operation of unloading the package 7, a winding tube chucker 34 relating to an operation of setting the winding tube 10, and a yarn capturing device 35 relating to a yarn capturing operation.

[0042] The device 3 also comprises a device controller 30 that drivingly controls the device relating to a doffing operation.

[0043] When the doffing device 3 executes a doffing operation, the doffing device 3 moves to a front position (an operation position P in Figure 3) in front of the winding unit 2 on which a doffing operation is to be executed, and the doffing device 3 then executes a doffing operation on the winding unit 2 positioned opposite the doffing device 3.

[0044] A control system for the winder 1 will be described with reference to Figure 1.

[0045] The winder 1 comprises a device relating to a control of various devices provided in the winder 1, including a host computer 50 that generally controls the entire winder 1, unit controllers 20 that drivingly control the respective winding units 2, and a device controller 30 that drivingly controls the doffing device 3.

[0046] The unit controller 20 is provided in the winding unit 2, and the device controller 30 is provided in the doffing device 3, and the host computer 50 is provided in the main body control section 5.

[0047] The host computer 50 is connected to each of the unit controllers 20 and the device controller 30 via a communication line 15 to generally control the controllers 20, 30. The controllers 20, 30 and host computer 50 constitute a control system of the winder 1.

[0048] The controllers 20, 30 and the host computer 50 are configured as an arithmetic device, a storage device and a control device out of four main parts of the computer, that is, the arithmetic device, the storage device, an input/output device and the control device (the control device herein means a device controlling the arithmetic device, storage device and input/output device).

[0049] In the case of the host computer 50, the input/output device corresponds to an external device connected to the host computer 50, and includes an input device (for example, a keyboard) used by an operator to perform input operations, an output device (for example, a display) that allows the operator to determine the operational state of the winder 1, and the controllers 20, 30. In the case of the unit controller 20, the input/output device corresponds to various devices (the yarn defect detecting device 24, the winding device 26 and the like) provided in the winding unit 2. In the case of the device controller 30, the input/output device corresponds to various devices (the cradle opener 33 and the like) provided in the doffing device 3.

[0050] A traveling route for the doffing device 3 will be described with reference to Figure 3.

[0051] The winder 1 comprises a plurality of winding units 2 (in the present embodiment, 60 winding units) arranged in a line, and each of the winding units 2 is provided with a unit number as inherent ID information. In the figures, unlike the reference numerals for the members of the devices and so on, the unit number is shown in parentheses: For example, the unit number 5 is shown as (5) .

[0052] The doffing device 3 is constructed to travel along the rails 12 arranged in parallel to and along the direction in which the winding units 2 are arranged. The doffing device 3 can move to the front position in front of any one of winding units 2 provided in the winder 1 and execute a doffing operation on any one of winding units 2. Here, the front position in front of the winding unit 2 is the position where the doffing device 3 stops to execute a doffing operation on that winding unit 2. This position is defined as an operation position for a doffing operation (hereinafter simply referred to as "operation position") P. The operation position P is provided for each winding unit 2.

[0053] The traveling route (rails 12) for the doffing device 3 is a linear path formed by connecting the operation positions P together in series. The doffing device 3 can travel (reciprocate) in both directions along the rails 12.

[0054] In case of stopping a traveling, the doffing device 3 stops at any one of the operation positions P regardless of whether or not a doffing operation is to be executed. The doffing device 3 does not stop between the operation positions P, P.

[0055] In the present embodiment, the traveling route for the doffing device 3 is a linear reciprocating route. However, the present invention is not limited to a segment-like route with opposite ends. An endless looped route may be used provided that the route comprises a unicursal single track without any branch.

[0056] When any one of the winding units 2 transmits

a full package signal or a near full package signal, the doffing device 3 is controlled to travel to the winding unit, which have transmitted the signal.

[0057] When the package 7 becomes full, the winding unit 2 transmits a full package signal to the doffing device 3 via the communication line 15. A state when the package 7 becomes full means that the length over which a yarn 8 has been wound around the winding tube 10 reaches a given value corresponding to a predetermined upper limit. Upon receiving a full package signal, the doffing device 3 moves to the winding unit 2 having transmitted the full package signal to execute a doffing operation on the winding unit 2.

[0058] In addition, when the package 7 is nearly full, the winding unit 2 transmits a near full package signal. A state when the package 7 is nearly full means that the length over which the yarn 8 has been wound around the winding tube 10 reaches a predetermined given value smaller than the value for a full package (for example, 95% of the length for a full package). Accordingly, the winding unit 2 transmits a near full package signal before transmitting a full package signal. Upon receiving a near full package signal, the doffing device 3 moves to the winding unit 2 having transmitted the near full package signal, and the doffing device 3 then stops at the operation position P of the winding unit 2 and waits for a full package signal from the winding unit 2. A full package signal from the winding unit 2 causes the doffing device 3 to immediately execute a doffing operation on the winding unit 2.

[0059] The unit controller 20 in the winding unit 2 has a predetermined length reach signal transmitting means 20a for transmitting a full package signal and a near full package signal. The predetermined length reach signal transmitting means 20a transmits a near full package signal when the winding length of the package 7 in the winding unit 2 with the predetermined length reach signal transmitting means 20a reaches the value for a near full package, and the predetermined length reach signal transmitting means 20a transmits a full package signal when the winding length of the package 7 in the winding unit 2 with the predetermined length reach signal transmitting means 20a reaches the value for a full package.

[0060] In this case, the unit controller 20 recognizes the winding length of the package 7 by measuring the rotation number of the traversing drum 28 or the winding time. The predetermined length reach signal transmitting means 20a transmits a near full package signal or a full package signal on the basis of the recognized result of the winding length.

[0061] Where only one of the winding units 2 in the winder 1 (all the winding units 2 for which the single doffing device 3 is responsible) transmits a full package signal or a near full package signal, that winding unit 2 is set to be an execution target for a doffing operation. Then, upon receiving a full package signal, the doffing device 3 immediately executes a doffing operation on the transmitting winding unit 2. Upon receiving a near full package signal, the doffing device 3 is caused to stand by until the doffing device 3 receives a full package signal, and then, the doffing device 3 executes a doffing operation on the transmitting winding unit 2.

[0062] On the other hand, where a plurality of winding units 2 in the winder 1 transmit a near full package signal or a full package signal, then in order to improve the efficiency of doffing operations, the order in which a doffing operation is executed on these winding units 2 needs to be appropriately set to set the execution target for a doffing operation on the basis of the set order.

[0063] Accordingly, the winder 1 includes a means for appropriately setting one of the winding units 2 to be the execution target for a doffing operation.

[0064] As shown in Figure 5, as a means for appropriately setting one of the winding units 2 to be the execution target for a doffing operation, a winding state storing means 30a, a winding state recognizing means 30b and target setting means 30c are provided in the device controller 30.

[0065] The winding state storing means 30a stores a set of a full package signal or a near full package signal transmitted from each of the winding units 2 and the unit number (identification information) of the transmitting winding unit 2.

[0066] For a near full package signal, the winding state storing means 30a stores a set of information on the transmission time and the unit number. The information stored in the winding state storing means 30a, that is, a full package signal or a near full package signal and the information on the transmission time of a near full package signal and the unit number, is hereinafter referred to as winding state information.

[0067] The winding state recognizing means 30b recognizes the winding length of the package 7 in each of the winding unit 2 to be longer or shorter on the basis of the winding state information stored in the winding state storing means 30a.

[0068] The winding state recognizing means 30b recognizes the package 7 in the winding unit 2 having transmitted a full package signal to be full (the winding length has reached the upper limit value). For the winding length of the package 7 in the winding unit 2 having transmitted a near full package signal, the winding state recognizing means 30b recognizes the package 7 in a winding unit 2 with an earlier transmission time to be nearer full. Thus, when a plurality of winding units 2 transmit a near full package signal, the winding state recognizing means 30b recognizes that the package 7 in a winding unit 2 with an earlier transmission time has a longer winding length (on the basis of comparison of near full packages with one another), and the winding state recognizing means 30b recognizes that the package 7 in a winding unit 2 with a later transmission time has a shorter winding length (on the basis of comparison of near full packages with one another).

[0069] In this case, a package 7 with a longer winding length is nearer full, so that a doffing operation should

be preferentially executed on this package 7. Therefore, the use of the recognized result made by the winding state recognizing means 30b provides information required to determine the preferential order of execution of a doffing operation where a plurality of winding units 2 transmit a near full package signal.

[0070] The target setting means 30c determines the winding length in each of the winding units 2 to be longer or shorter on the basis of the recognized result made by the winding state recognizing means 30b. The target setting means 30c sets the winding unit 2 on which a doffing operation is to be executed by giving top priority to a winding unit 2 with a winding length corresponding to a full package, and by setting priorities for winding units 2 with less full packages in order of nearer to a full package. The device controller 30 moves the doffing device 3 to the winding unit 2 set to be the execution target.

[0071] In this case, top priority in execution order is given to a winding unit 2 with a full package because the winding unit 2 is ready for an immediate doffing operation. Winding units 2 with near full packages are not ready for an immediate doffing operation but can be subjected to a doffing operation earlier than winding units with packages not near full. Thus, winding units with near full packages are priorized next to winding units with full packages. Further, when a plurality of winding units 2 have near full packages, a winding unit 2 with a nearer full package gets ready for an immediate doffing operation earlier. Consequently, a doffing operation is executed earlier on a winding unit with a nearer full package.

[0072] When a plurality of winding units 2 have full packages, the target setting means 30c sets the winding unit 2 on which a doffing operation is to be executed, in order of shorter distance from the current position of the doffing device 3 to the winding unit 2. Here, the distance from the doffing device 3 to the winding unit 2 means the distance between the operation position P where the doffing device 3 is located and the operation position P corresponding to the winding unit 2.

[0073] The execution target is set in this order (the order of shorter distance) when a plurality of winding units have full packages. This makes it possible to reduce the total distance over which the doffing device 3 needs to move when the doffing device 3 moves to these winding units 2 for a doffing operation. This in turn reduces the time for which the winding unit 2 must suspend a winding operation in order to stand by for a doffing operation, enabling the prevention of a decrease in the operational efficiency of the entire winding units 2.

[0074] The target setting means 30c resets the winding unit 2 on which the next doffing operation is to be executed every time any winding unit 2 transmits a near full package signal or a full package signal, that is, every time the recognized result of the winding state of each of the winding units 2 made by the winding state recognizing means 30b is changed. This is because the preferential execution target for a doffing operation changes when, for example, the near full package in any one of the winding units 2 has become full.

[0075] The device controller 30 includes an operation standby means 30d for causing the doffing device 3 to stand by without executing a doffing operation after the doffing device 3 reaches a winding unit 2 on which a doffing operation is to be executed and until the package 7 being formed by the winding unit 2 becomes full.

[0076] Figure 4 shows that a plurality of winding units have a full package or a near full package.

[0077] Here, the winding units 2 with unit numbers (10), (21) have full packages (the checkered winding units 2 in Figure 4). The winding units 2 with unit numbers (12), (20) have near full packages (the shaded winding units 2 in Figure 4). In addition, concerning the transmission time of a near full package signal, the winding unit 2 with unit number (20) is assumed to transmit a near full package signal earlier than the winding unit 2 with unit number (12).

[0078] The other winding units 2 have winding lengths not having reached the value for a near full package and are thus not shown with any pattern. At this time, the doffing device 3 is assumed to lie at the operation position P of the winding unit 2 with unit number (14) (the doffing device 3 is passing by or is stopped at the operation position P).

[0079] In the case shown in Figure 4, the target setting means 30c sets the execution target for a doffing operation in the order described below.

[0080] The first execution target is the winding unit 2 with unit number (10), and the second execution target is the winding unit 2 with unit number (21).

[0081] This is because both winding units 2 with unit numbers (10), (21) have full packages and because the distance from the current position of the doffing device 3 to the winding unit 2 with unit number (10) is shorter than that from the current position of the doffing device 3 to the winding unit 2 with unit number (21). In this case, the distance between the operation positions P, P (the distance is equal to one winding unit) D is fixed. The distance L1 between the doffing device 3 and the winding unit 2 with unit number (10) is equal to four winding units. The distance L2 between the doffing device 3 and the winding unit 2 with unit number (21) is equal to seven winding units. The winding unit 2 with unit number (10) is closer to the doffing device 3 by a distance equal to three winding units.

[0082] The third execution target is the winding unit 2 with unit number (12), and the fourth execution target is the winding unit 2 with unit number (20).

[0083] The winding units 2 with unit numbers (12), (20) have near full packages and are thus subjected to a doffing operation later than the winding units 2 with unit numbers (10), (21), both of which have a full package. For the winding units 2 with unit numbers (12), (20), having near full packages, priority is given to the winding unit 2 having transmitted a near full package signal earlier. Consequently, priority is given to the winding unit 2 with unit number (20) over the winding unit 2 with unit number

(12).

[0084] When the doffing device 3 reaches the winding unit 2 set by the target setting means 30c to be the execution target for a doffing operation, the device controller 30 causes the doffing device 3 to immediately start a doffing operation when the execution target winding unit 2 has a full package. When the execution target winding unit 2 has a near full package, the operation standby means 30d causes the doffing device 3 to stand by at the operation position P of that winding unit 2 until the near full package becomes full. Once the package 7 in the winding unit 2 becomes full, the device controller 30 causes the doffing device 3 to start a doffing operation.

[0085] The above priority order for execution of a doffing operation takes place when the doffing device 3 is located at the operation position P of the winding unit 2 with unit number (14) as shown in Figure 4.

[0086] For example, where the near full package in the winding unit 2 with unit number (20) becomes a full package when the a doffing operation is finished on the winding unit 2 with unit number (10), which is the first execution target, the target setting means 30c sets the execution target for the next doffing operation to be the winding unit 2 with unit number (20) instead of the winding unit 2 with unit number (21). This is because the winding unit 2 with unit number (20) is closer to the current position (which corresponds to the operation position P of unit number (10)) of the doffing device 3 than the winding unit 2 with unit number (21).

[0087] Regardless of the winding length, the target setting means 30c does not set a winding unit 2 disabled from undergoing doffing operation to be the execution target for a doffing operation.

[0088] For example, a winding unit 2 is disabled from undergoing a doffing operation when the full package 7 already unloaded from the winding unit 2 remains in the package receiver 13, so that the full package 7 now held by the cradle 27 cannot be unloaded onto anywhere. In this case, the disabled winding unit 2 is excluded from choices for the execution target for a doffing operation regardless of the winding length (that is, even if the winding unit has a full package) so that the winding unit 2 is neglected to allow a doffing operation to be executed on another winding unit 2.

[0089] An arrangement for traveling control of the doffing device 3 will be described with reference to Figure 5.

[0090] To allow the doffing device 3 to appropriately travel to the winding unit 2 on which a doffing operation is to be executed, a system for controlling traveling of the doffing device 3 is provided in the winder 1.

[0091] The traveling control system comprises means for setting the execution target position for a doffing operation (the above-described target setting means 30c), a means for drivingly controlling the traveling device 32 in accordance with a setting for the execution target position (travel driving controlling means 30e), and a means for recognizing the current position of the doffing device 3.

[0092] The target setting means 30c has been described above.

[0093] The travel driving controlling means 30e controls driving of a driving source (motor) provided in the traveling device 32 so that the doffing device 3 can reach the execution target position (the operation position P of the target winding unit 2) set by the target setting means 30c.

[0094] The current position recognizing means will be described below.

[0095] The means for recognizing the current position of the doffing device 3 is composed of a means for recognizing the current position of the doffing device 3 while the doffing device 3 is at a stop (current stopped position recognizing means) and a means for detecting the current position of the doffing device 3 while the doffing device 3 is traveling (current traveling position recognizing means).

[0096] The current (stopped and traveling) position recognizing means recognize the current position of the doffing device 3, and more specifically, recognize at which operation position P the current position is located on the rails 12.

[0097] A description will be given of an arrangement for recognition of the current position of the doffing device 3 in a stopped state.

[0098] A current stopped position recognizing means 30f is provided in the device controller 30 of the doffing device 3. The current stopped position recognizing means 30f is a means that recognizes the current position of the doffing device 3 when the doffing device 3 stops at any one of the operation positions P.

[0099] The doffing device 3 and the devices provided in the winding unit 2 are used to constitute a means for providing determination materials for allowing the current stopped position recognizing means 30f to recognize the current position.

[0100] The current stopped position recognizing means 30f recognizes the current position of the doffing device 3 on the basis of the determination materials received from the following means.

[0101] One of the means is an operation position detecting means for detecting whether or not the doffing device 3 is located at any one of operation positions P.

[0102] Another means is an ID information acquiring means for acquiring, when the doffing device 3 is stopped at any one of the operation position P, the unit number (ID information) of the winding unit 2 corresponding to the operation position P where the doffing device 3 is stopped.

[0103] The operation position detecting means will be described.

[0104] The operation position detecting means is composed of an index plate 41 provided on each winding unit 2 in association with its operation position P and an index plate detecting sensor 61 provided in the doffing device 3.

[0105] When the doffing device 3 is located at any one of the operation positions P, the index plate 41 corresponding to that operation position P is detected by the

index plate detecting sensor 61. The index plate detecting sensor 61 detects the index plate 41 only where the doffing device 3 is located at any one of the operation positions P (that is, when the doffing device 3 is stopped at or is just passing by the operation position P). The index plate detecting sensor 61 does not detect the index plate 41 where the doffing device 3 is located at a position other than the operation positions P (that is, when the doffing device 3 is traveling between the operation positions P, P).

[0106] Thus, when the index plate detecting sensor 61 detects the index plate 41, the doffing device 3 is clearly located at any one of the operation positions P (the doffing device 3 is stopped at or is passing by the operation position P) even though at which operation position P the doffing device 3 is located is unknown. The index plate detecting sensor 61 is connected to the device controller 30 for signal communications, and detection information obtained by the index plate detecting sensor 61 is recognized by the device controller 30.

[0107] The ID information acquiring means will be described.

[0108] The ID information acquiring means is composed of an ID request receiving device 42 provided in each winding unit 2 in association with its operation position P, an ID request transmitting device 62 provided in the doffing device 3, an ID return instructing means 20b for instructing the winding unit 2 to return its ID information to the doffing device 3 on the basis of an ID request transmitted from the ID request transmitting device 62, and a communication device that communicatively connects the unit controller 20 and the device controller 30 together.

[0109] The ID request transmitting device 62 is provided in the doffing device 3 to transmit an ID request signal to the ID request receiving device 42 provided in association with the operation position P. In the present embodiment, the ID request receiving device 42 is provided in the winding unit 2.

[0110] The ID request signal is transmitted by the doffing device 3 stopped at a certain operation position P, to the winding unit 2 (unit controller 20) corresponding to the operation position P where the doffing device 3 is stopped, in order to request the winding unit 2 to return its ID information (in the present embodiment, its unit number) to the doffing device 3 (device controller 30). The ID request signal is, for example, an optical signal. The ID request transmitting device 62 is a light emitting device, and the ID request receiving device 42 is a light receiving device.

[0111] Transmission of an ID request signal by the ID request transmitting device 62 is triggered by the stop of the doffing device 3 at the operation position P.

[0112] The ID request transmitting device 62 is connected to the device controller 30 for signal communications to recognize that the doffing device 3 is stopped at the operation position P on the basis of information on the index plate 41 detected by the index plate detecting sensor 61 and on the driving stopped state of the traveling device 32 detected by the travel driving controlling means 30e. Upon receiving an ID request signal, the ID request receiving device 42 transmits the received signal to the ID return instructing means 20b, provided in the unit controller 20. The ID request receiving device 42 is connected to the unit controller 20 for signal communications.

[0113] When the ID request receiving device 42 receives an ID request signal, the ID return instructing means 20b, provided in the winding unit 2, instructs the unit controller 20 to return the unit number (ID information) to the device controller 30.

[0114] In the winder 1, the communication device communicatively connecting the unit controllers 20 and the device controller 30 together for signal communications is composed of the communication line 15, a communication input/output instrument that connects the communication line 15 and the unit controller 20 together, and a communication input/output instrument that connects the communication line 15 and the device controller 30 together.

[0115] The configuration of the communication device, which is responsible for transmitting and receiving ID request signal and unit number and communicatively connects the unit controllers 20 and the device controller 30 together, is not limited to the wired type utilizing the communication line 15. The communication device may be of a wireless type. In particular, where RFIC tags (arranged in the winding units 2) and a tag reader (placed in the doffing device 3) are utilized as a wireless communication device, storing each unit number in a memory in the corresponding RFIC tag allows the unit number to be returned to the doffing device 3 without using the unit controller 20.

[0116] The current stopped position recognizing means 30f is provided in the device controller 30.

[0117] The current stopped position recognizing means 30f determines the operation position P where the doffing device 3 is stopped, on the basis of ID information returned in response to an instruction from the ID return instructing means 20b. In this case, the ID request transmitting device 62 has transmitted the ID request signal to the winding unit 2 located at the position (operation position P) in front of the doffing position 3, and the unit number returned from the winding unit 2 is returned to the device controller 30 via the communication line 15. Of course, the winding unit 2 specified by the unit number is the winding unit 2 located at the front position (operation position P) in front of the doffing device 3.

[0118] A description will be given of an arrangement relating to a recognition of a current position of the doffing device 3 during traveling.

[0119] A current traveling position recognizing means 30h is provided in the device controller 30 of the doffing device 3. The current traveling position recognizing means 30h recognizes the current position of the doffing device 3 while the doffing device 3 is traveling along the route (rails 12).

[0120] Although described below in detail, the current position that can be determined by the current traveling position recognizing means 30h is not an arbitrary position on the route (rails 12) but is a particular operation position P, that is, the last operation position P that the doffing device 3 passed before reaching the current position (or the operation position P being passed by the doffing device 3).

[0121] The doffing device 3 and the devices provided in the winding unit 2 are used to constitute a means for providing determination materials that allow the current traveling position recognizing means 30h to recognize the current position of the doffing device 3.

[0122] The current traveling position recognizing means 30h recognizes the current position of the doffing device 3 on the basis of determination materials received from the following means.

[0123] One of the means is an operation position detecting means for detecting whether or not the doffing device 3 is located at any one of the operation positions P.

[0124] Another means is a count means 30g for, when the doffing device 3 travels along the route (rails 12), counting the number of operation positions P passed by the doffing device 3 between the last operation position P at which the doffing device 3 stopped and the current traveling position of the doffing device 3.

[0125] The operation position detecting means has already been described in conjunction with the current stopped position recognizing means 30f.

[0126] The operation position detecting means is composed of the index plate 41 provided in the winding unit 2 in association with its operation position P and the index plate detecting sensor 61 provided in the doffing device 3. While the doffing device 3 is traveling (the traveling device 32 is being driven), each detection of the index plate 41 by the index plate detecting sensor 61 clearly indicates that the doffing device 3 has passed an operation position P.

[0127] The count means 30g will be described.

[0128] The count means 30g is provided in the device controller 30 to count the number of index plates 41 (that is, operation positions P) detected by the index plate detecting sensor 61. In this case, the count means 30g counts the number of operation positions P passed by the doffing device 3 between the last operation position P where the doffing device 3 stopped and the current traveling position. The count information (the number of operation positions passed by the doffing device 3 between the last operation position P where the doffing device 3 stopped and the current position) indicates the traveling distance from the last operation position P where the doffing device 3 stopped to the current traveling position.

[0129] The current traveling position recognizing means 30h is provided in the device controller 30.

[0130] The current traveling position recognizing means 30h recognizes the current position of the traveling doffing device 3 on the basis of the ID information (unit number) indicating the last operation position where the doffing device 3 stopped and the number of operation positions P (the number of index plates 41 detected by the count means 30g) passed by the doffing device 3 between the last operation position where the doffing device 3 stopped and the current position.

[0131] As previously described, exactly speaking, the current traveling position recognizing means 30h recognizes the last operation position P passed by the traveling doffing device 3.

[0132] In the present embodiment, the unit number indicating the winding unit 2 is a number set on the basis of the number of winding units 2 arranged in the winder 1. The current position of the traveling doffing device 3 can be determined by adding or subtracting the counted number provided by the count means 30g depending on the traveling direction.

[0133] For example, it is assumed that the winding units 2 arranged from left to right along the rails 12 are sequentially provided with unit numbers (1) to (60). In this case, where unit number (10) corresponds to the last operation position P when the doffing device 3 stopped, the doffing device 3 travels from left to right, and the counted number is 3, the current position of the traveling doffing device 3 is the operation position P corresponding to the winding unit 2 with unit number (13). In contrast, where the doffing device 3 travels from right to left and the counted number is 6, the current position of the traveling doffing device 3 is the operation position P corresponding to the winding unit 2 with unit number (4).

[0134] The unit number, serving as ID information, may be a symbol and the like instead of a number. In this case, a table is prepared which shows the correspondences between the numbers of index plates 41 detected and the unit numbers. The correspondence table is stored in device controller 30. The current position of the traveling doffing device 3 is recognized with reference to the correspondence table on the basis of the recognized traveling direction of the doffing device 3 and the counted number (the number of index plates 41 detected). The traveling direction of the doffing device 3 can be recognized by the travel driving controlling means 30e, which drivingly controls the traveling device 32.

[0135] As described above, with the arrangement utilizing the method of determining the current position on the basis of the number of operation positions P passed by the doffing device 3, it is unnecessary to use, every time the doffing device 3 stops at the operation position P, the current stopped position recognizing means 30f to determine the current position corresponding to that operation position P. Even while the doffing device 3 is at a stop, the current position can be determined using the current traveling position recognizing means 30h

[0136] However, the current traveling position recognizing means 30h is configured to detect the current position of the doffing device 3 while the doffing device 3 is traveling or stopped provided that the last operation position P where the doffing device 3 stopped has been

accurately determined. That is, the current traveling position recognizing means 30h is configured to determine the next current position utilizing a relative positional relationship. Consequently, once the current traveling position recognizing means 30h fails to determine the last operation position P where the doffing device 3 stopped, the means 30h subsequently recognizes the current position erroneously.

[0137] Thus, as previously described, in the winder 1, every time the doffing device 3 stops, the doffing device 3 stopped at the operation position P of any one of the winding units 2 requests the ID information to the winding unit 2 by using the current stopped position recognizing means 30f in order to obtain absolute positional information on the operation position P. This improves the reliability of control of the current position.

[0138] The control of stop of the doffing device 3 is performed as described below.

[0139] The device controller 30 uses the current traveling position detecting means 30h to constantly determine the current position of the doffing device 3 while the doffing device 3 is traveling. The device controller 30 also uses the current traveling position detecting means 30h to recognize whether or not the next operation position P the doffing device 3 is to pass is the operation position P on which a doffing operation is to be executed. Thus, before the doffing device 3 reaches the operation position P on which a doffing operation is to be executed, the travel driving controlling means 30e has decelerated the driving effected by the traveling device 32. Then, when the index detecting sensor 61 detects the index plate 41 corresponding to the operation position P, the travel driving controlling means 30e stops the driving effected by the traveling device 32.

[0140] Now, with reference to Figure 6, a description will be given of the flow of a doffing operation executed by the doffing device 3. This flow of traveling control indicates a process procedure executed by the device controller 30, provided in the doffing device 3, to control traveling of the doffing device 3.

[0141] The winder 1 or the doffing device 3 is actuated to start the flow of traveling control of the doffing device 3. When the flow is started, the doffing device 3 is in a standby state (step 100).

[0142] In Figure 6, the winding unit 2 is simply referred to as the "unit" to also simplify the illustration.

[0143] In the state that the process shifts to a traveling standby state (step 100), the device controller 30 checks whether or not the device controller 30 recognizes the self position (the current position of the doffing device 3). Where the device controller 30 does not recognize the self position, the process shifts to step 102. Where the device controller 30 recognizes the self position, the process shifts to step 103.

[0144] Step 102 (the self position is not recognized) is executed when the device controller 30 does not recognize the current position of the doffing device 3 because the doffing device 3 has failed to acquire the unit number of the winding unit 2 corresponding to any one of the operation positions P: For example, the doffing device 3 has not been stopped at any one of the operation positions P.

[0145] In this case, the device controller 30 stops the doffing device 3 at a nearby winding unit 2 to acquire the unit number of the winding unit 2 (INDEX IN). Specifically, the doffing device 3 is moved in either direction on the rails 12 and then stopped when the index detecting sensor 61 detects the index plate 41.

[0146] Once the unit number is successfully acquired, the process proceeds to step 103.

[0147] In step 103 (the self position is recognized), the device controller 30 determines whether or not any one of the winding units 2 in the winder 1 has a full package.

[0148] Where no winding unit 2 has a full package, the process shifts to step 104. Where any one of the winding unit 2 has a full package, the process shifts to step 105.

[0149] In step 104 (no winding unit has a full package), the device controller 30 determines whether or not the winder 1 has any one of the winding units 2 with a near full package.

[0150] Where no winding unit 2 has a near full package, the process shifts to step 100, and where any one of the winding unit 2 has a near full package, the process shifts to step III.

[0151] In short, where the process shifts to step 105, at least one winding unit 2 has a full package, and the winder 1 may have a winding unit(s) 2 with a near full package. Where the process shifts to step 111, the winder 1 has a winding unit(s) 2 with a near full package, but no winding unit 2 has a full package. Where the process shifts to step 100, no winding unit 2 has a full package or a near full package.

[0152] In step 105 (the winder 1 has a full package unit (s)), where a plurality of winding units 2 have a full package, the device controller 30 compares, for the plurality of winding units 2 with a full package, the distances from the current position of the doffing device 3 to each of the winding unit 2 with a full package.

[0153] In step 106, the device controller 30 sets the winding unit 2 on which a doffing operation is to be executed to be the winding unit 2 with a full package which is closest to the current position of the doffing device 3.

[0154] In step 107, the device controller 30 causes the doffing device 3 to travel to the winding unit 2 set to be the execution target for a doffing operation in step 106, and the device controller 30 then stops the doffing device 30 at the operation position P corresponding to the target winding unit 2.

[0155] In step 108, the device controller 30 causes the doffing device 3 to execute a doffing operation on the winding unit 2 set to be the execution target for a doffing operation.

[0156] In step 109, the device controller 30 determines whether or not any one of the winding unit 2 in the winder 1 has a full package or a near full package.

[0157] Where no winding unit 2 has a full package or

a near full package, the process shifts to step 110, and where any one of the winding unit 2 has a full package or a near full package, the process shifts to step S103.

[0158] When the process shifts to step 110, the winder 1 has no winding unit 2 that needs to undergo a doffing operation or will need to undergo a doffing operation in the near future (a full package or a near full package of the winding unit 2). The doffing device 3 is thus caused to stand by.

[0159] In step 110, the device controller 30 causes the doffing device 3 to move to a predetermined traveling standby position. The predetermined traveling standby position is set to be the operation position P of one of a group of winding units 2 provided in the winder 1 which, for example, is located in the center of the group (unit having a unit number (30) or (31) in the winder 1 comprising the 60 units). Alternatively, the predetermined traveling standby position is set to be the position of the winding unit 2 closer, by a distance equal to two winding units, to the center than the last winding unit on which a doffing operation was executed. Thus, in order to be more efficiently operated when a doffing operation subsequently needs to be executed, the doffing device 3 stands by at a position closer to the center of the rails 12 than the current position so as to move easily to a desired position on the rails 12.

[0160] Once the doffing device 3 is moved so as to stand by in step 110, the process shifts to step 100.

[0161] A description will return to the case where the process shifts to step III (the winder 1 has a near full package unit(s)).

[0162] In step 111, where a plurality of winding units 2 have a near full package, the device controller 30 searches for one of the plurality of winding units 2 with a near full package which is expected to complete a full package earliest at that moment. One of the winding units 2 with a near full package which transmitted a near full package signal earliest is expected to complete a full package earliest at that moment. The winding state of each winding unit 2 is recognized by the winding state recognizing means 30b. The device controller 30 can use this recognized result to determine the winding unit 2 expected to complete a full package earliest.

[0163] In step S112, the device controller 30 (target setting means 30c) sets the winding unit 2 expected to complete a full package earliest to be the one on which a doffing operation is to be executed.

[0164] In step 113, the device controller 30 causes the doffing device 3 to travel to the winding unit 2 set to be the execution target for a doffing operation in step 106 and then to stop at that operation position P corresponding to the target winding unit 2.

[0165] In step 114, the device controller 30 (operation standby means 30d) causes the doffing device 3 to stand by at the operation position P until the winding unit 2 set to be the execution target for a doffing operation completes a full package.

[0166] In step 115, the device controller 30 causes the doffing device 3 to execute a doffing operation on the winding unit 2 set to be the execution target for a doffing operation.

[0167] Once step 115 is finished, the process shifts to step 109 to execute a process similar to that described above.

[0168] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intented by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the invention.

Claims

1. A textile machine having a doffing device comprising a plurality of winding units each of which winds a yarn around a winding tube to form a package and a doffing device that moves to any of the winding units to execute a doffing operation on the winding unit, the textile machine being **characterized by** comprising:

   a target setting means for setting the winding unit on which the doffing operation is to be executed by giving top priority to those winding units which have a winding length corresponding to a full package and by setting priorities for winding units with less full packages so that a higher priority is given to a winding unit having a winding length nearer to a full package; and
   an operation standby means for causing the doffing device to stand by without performing the doffing operation after the doffing device reaches the execution target winding unit and until the package being formed in the winding unit becomes full.

2. A textile machine having a doffing device according to Claim 1, **characterized by** comprising:

   a predetermined length signal transmitting means for, when the winding length of the package reaches a predetermined value smaller than the value for a full package, allowing the winding unit forming that package to transmit a predetermined length reach signal, and in that:

      the target setting means determines the winding length of the package in each of the winding unit to be longer or shorter, said longer or shorter length of the package being recognized on the basis of a transmission time at which each of the winding unit

transmits the predetermined length reach signal.

3. A textile machine having a doffing device according to Claim 1 or Claim 2, **characterized in that**:

when a plurality of the winding units have a winding length of a package corresponding to a full package, the target setting means sets the execution target in order of increasing distance from the current position of the doffing device to the winding unit.

Fig. 1

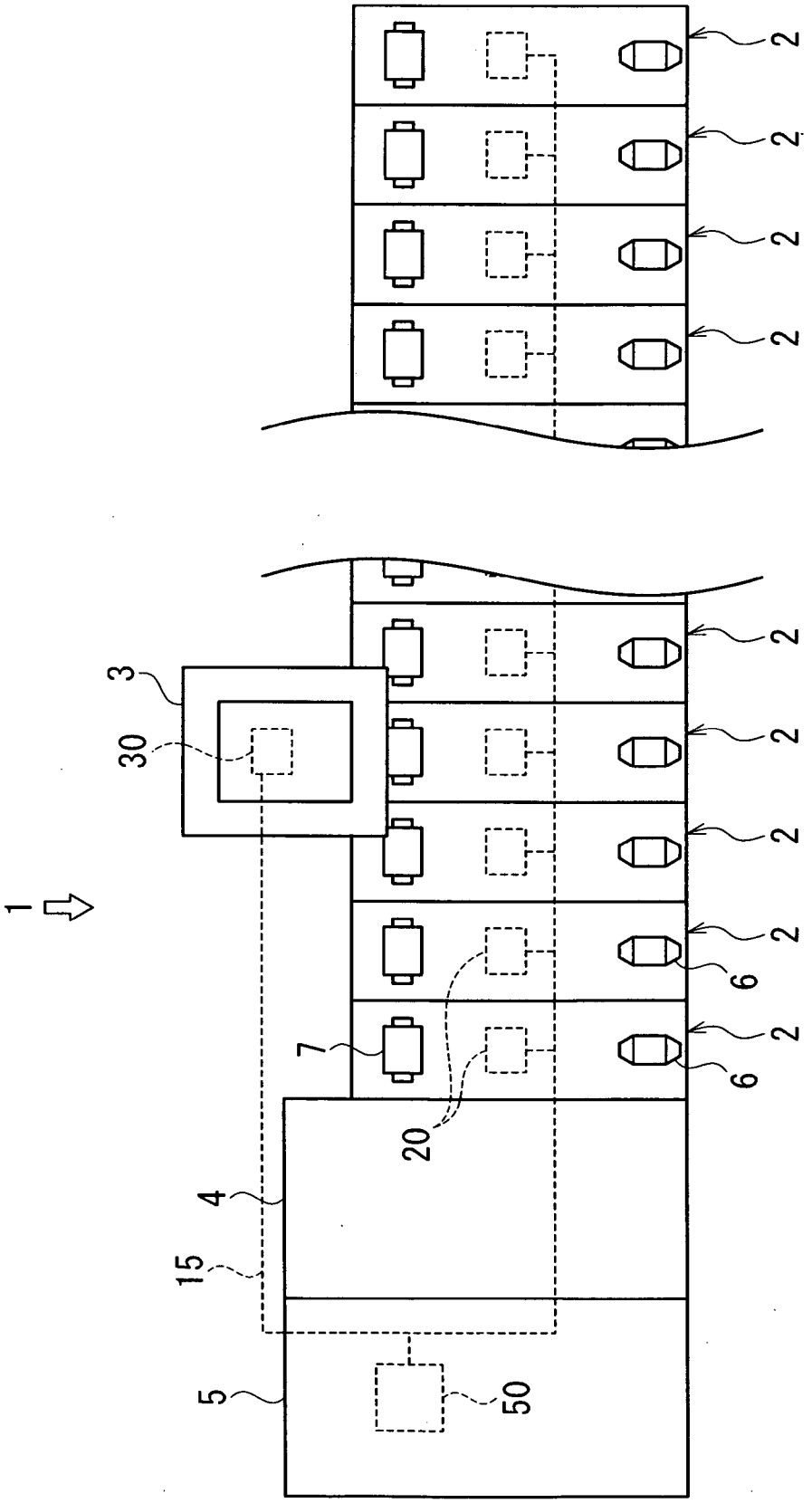


Fig. 2

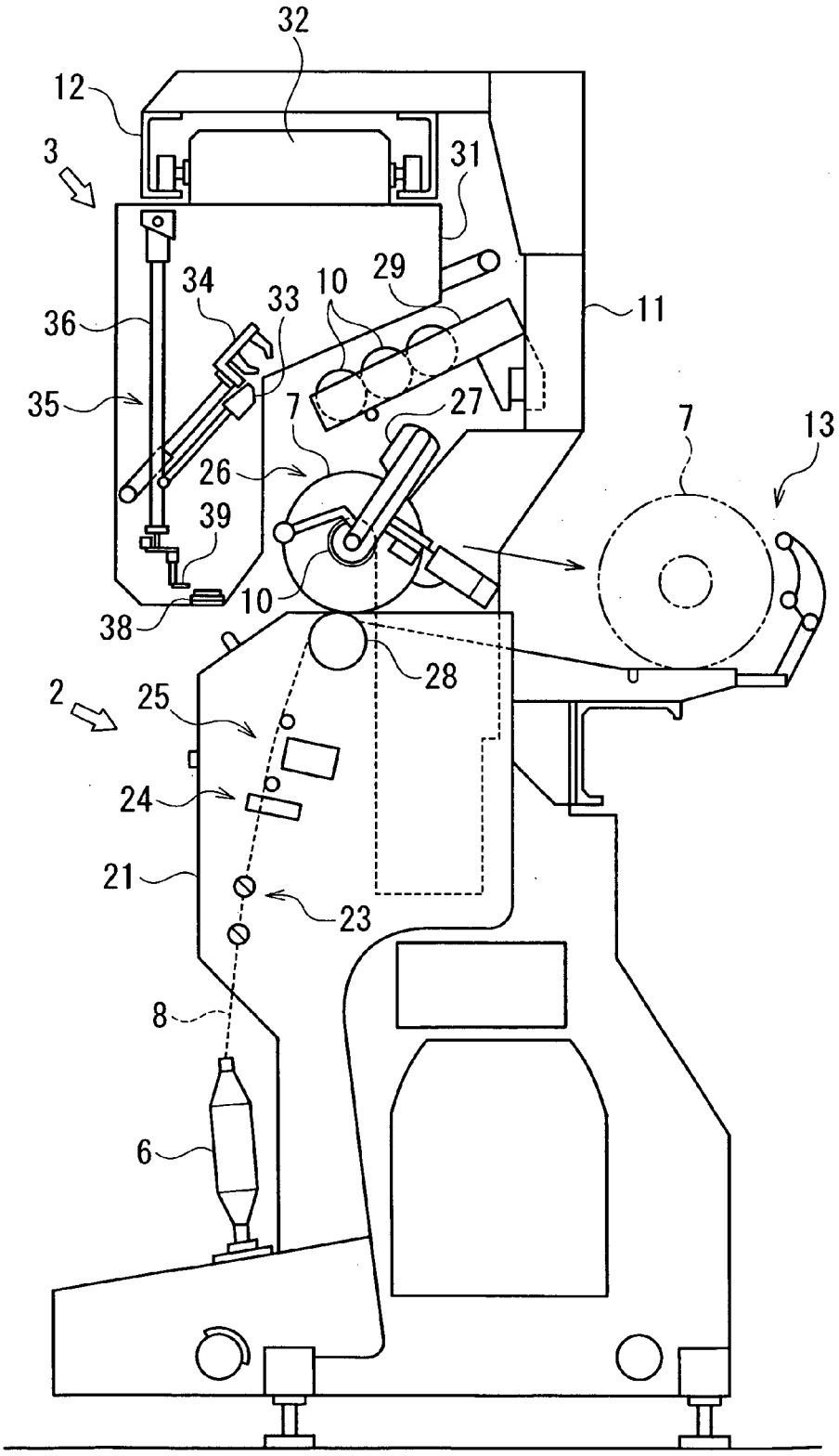


Fig. 3

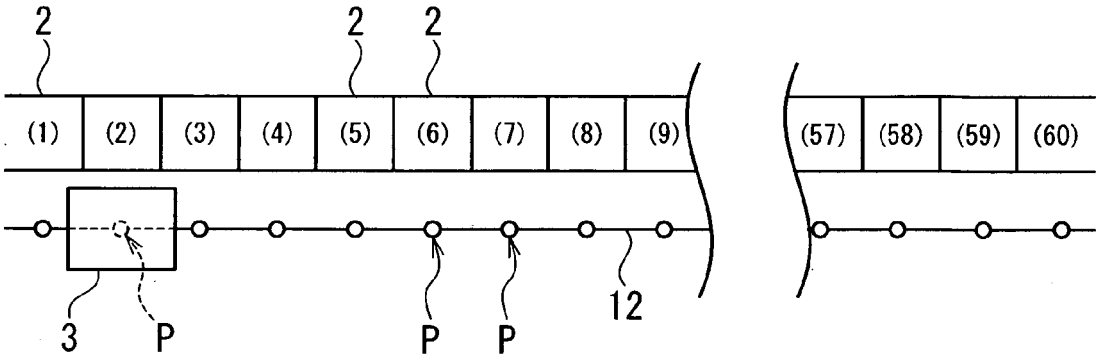

2
2
2
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(57)
(58)
(59)
(60)
3
P
P
P
12

Fig. 4

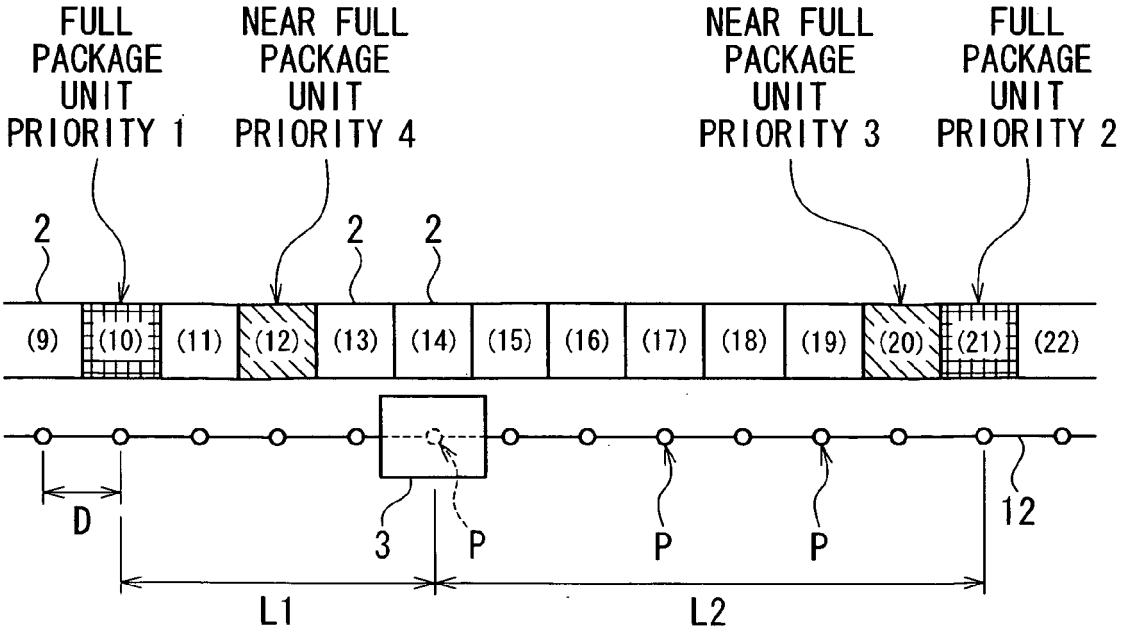

FULL PACKAGE UNIT PRIORITY 1
NEAR FULL PACKAGE UNIT PRIORITY 4
NEAR FULL PACKAGE UNIT PRIORITY 3
FULL PACKAGE UNIT PRIORITY 2
2
2
2
(9)
(10)
(11)
(12)
(13)
(14)
(15)
(16)
(17)
(18)
(19)
(20)
(21)
(22)
D
3
P
P
P
12
L1
L2

Fig. 5A

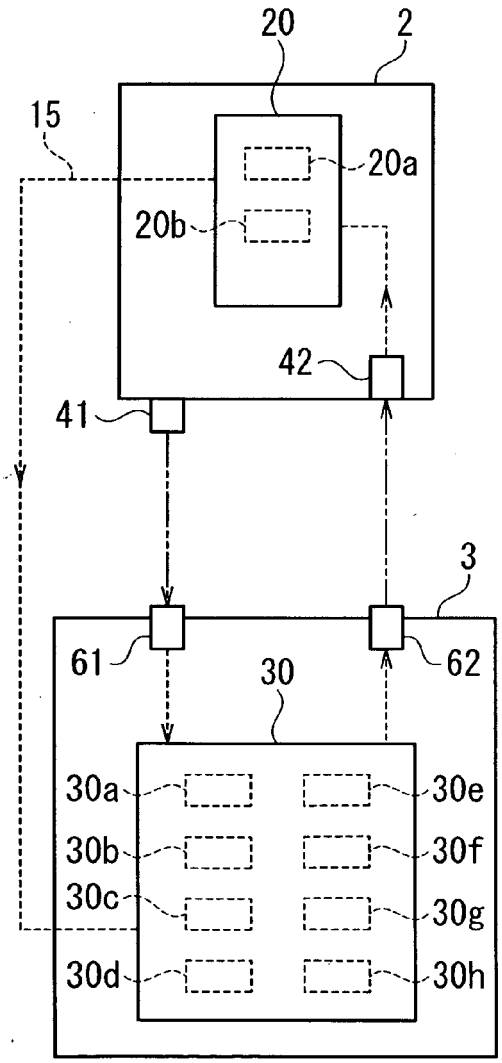

20
2
15
20a
20b
42
41
3
61
62
30
30a
30b
30c
30d
30e
30f
30g
30h

Fig. 5B

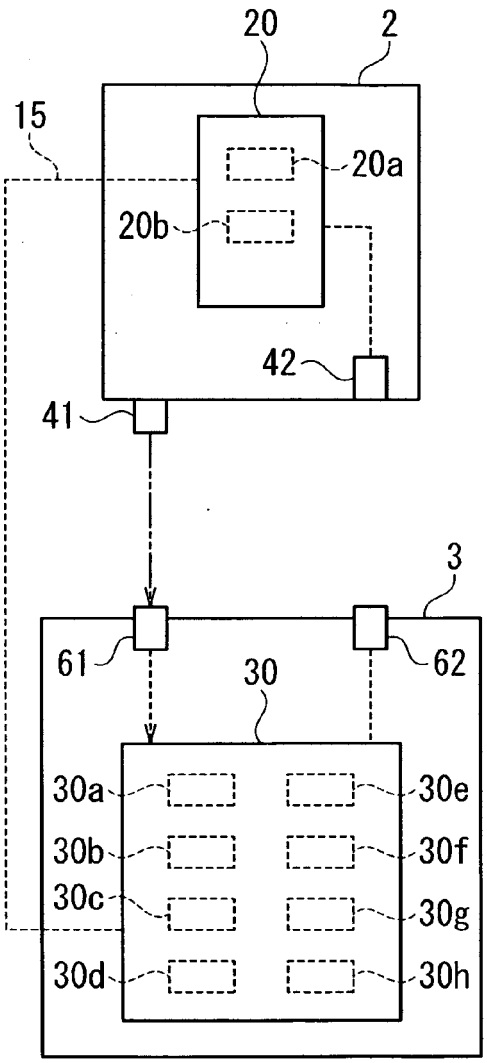
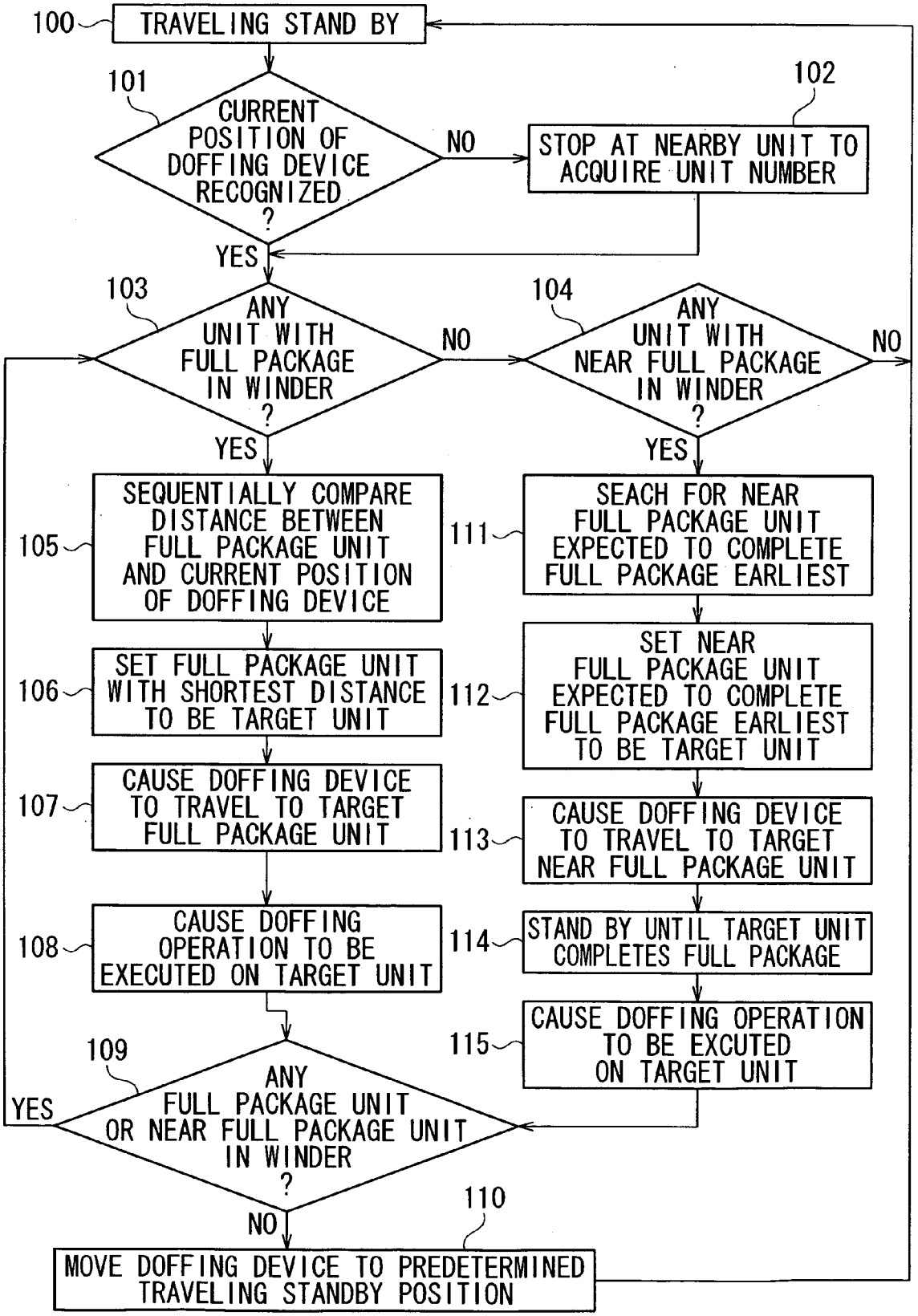

20
2
15
20a
20b
42
41
3
61
62
30
30a
30b
30c
30d
30e
30f
30g
30h

Fig. 6


100
TRAVELING STAND BY
101
CURRENT POSITION OF DOFFING DEVICE RECOGNIZED ?
NO
102
STOP AT NEARBY UNIT TO ACQUIRE UNIT NUMBER
YES
103
ANY UNIT WITH FULL PACKAGE IN WINDER ?
NO
104
ANY UNIT WITH NEAR FULL PACKAGE IN WINDER ?
NO
YES
YES
105
SEQUENTIALLY COMPARE DISTANCE BETWEEN FULL PACKAGE UNIT AND CURRENT POSITION OF DOFFING DEVICE
106
SET FULL PACKAGE UNIT WITH SHORTEST DISTANCE TO BE TARGET UNIT
107
CAUSE DOFFING DEVICE TO TRAVEL TO TARGET FULL PACKAGE UNIT
108
CAUSE DOFFING OPERATION TO BE EXECUTED ON TARGET UNIT
111
SEACH FOR NEAR FULL PACKAGE UNIT EXPECTED TO COMPLETE FULL PACKAGE EARLIEST
112
SET NEAR FULL PACKAGE UNIT EXPECTED TO COMPLETE FULL PACKAGE EARLIEST TO BE TARGET UNIT
113
CAUSE DOFFING DEVICE TO TRAVEL TO TARGET NEAR FULL PACKAGE UNIT
114
STAND BY UNTIL TARGET UNIT COMPLETES FULL PACKAGE
115
CAUSE DOFFING OPERATION TO BE EXCUTED ON TARGET UNIT
109
ANY FULL PACKAGE UNIT OR NEAR FULL PACKAGE UNIT IN WINDER ?
YES
NO
110
MOVE DOFFING DEVICE TO PREDETERMINED TRAVELING STANDBY POSITION

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 00 9247

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 August 2007	Guisan, Thierry

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 00 9247

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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31-08-2007

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REFERENCES CITED IN THE DESCRIPTION

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