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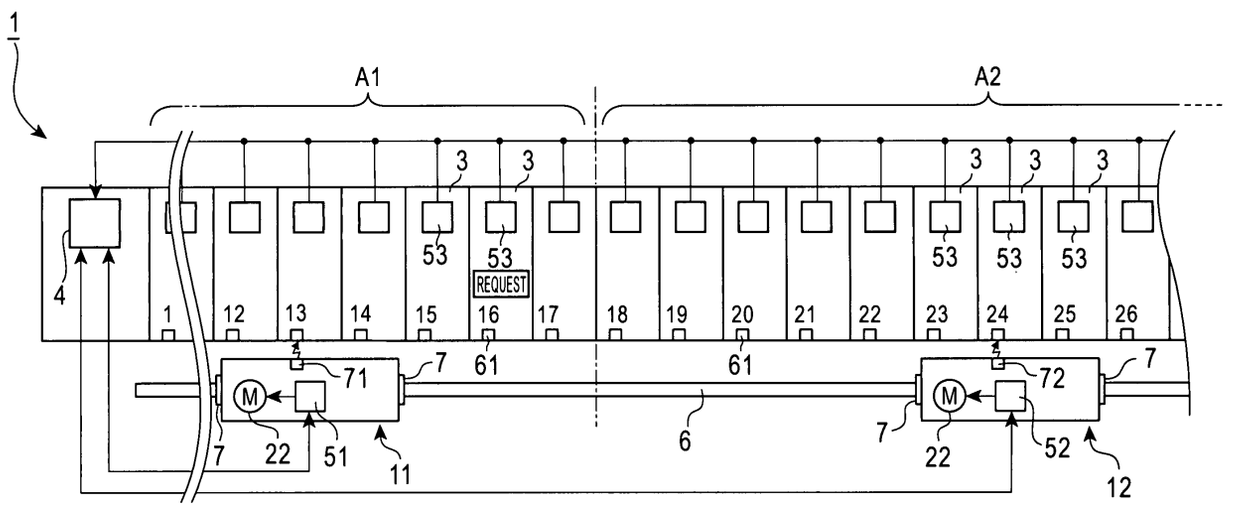
(54) Service carriage control system

(57) The present invention enables efficient operations in a control system that operates in response to a request for yarn splicing made by each of a plurality of processing units 3, to stop one of a plurality of service carriages running along the same running path 6, at the processing unit for yarn splicing. Work areas are assigned to yarn splicing carriages 11, 12; for example, spinning units 3 nos. 1 to 17 are assigned to the work area A1 of the first yarn splicing carriage 11 and spinning units 3 nos. 18 to 34 are assigned to the work area A2 of the second yarn splicing carriage 12. If the spinning unit 3 no. 18 makes a yarn yarn splicing request, the system performs control such that the second yarn yarn splicing carriage 12 is dispatched, which covers the work area A2 to which the spinning unit 3 no. 18 belongs. The first yarn splicing carriage 11 calculates the distance between the current position of the carriage 11 and the yarn splicing requesting unit (no. 18). If the distance has at most a predetermined value, the system performs control such that the second yarn splicing carriage is withdrawn and moved away from the yarn splicing requesting unit (Fig.1)

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to a service carriage control system that operates in response to a request for a service made by one of a plurality of processing units, to cause a service carriage to run to the unit to provide the unit with the service.

Background of the Invention

[0002] The Unexamined Japanese Patent Application Publication (Tokkai-Hei) 11-107078 discloses a spinning machine having a large number of spinning units installed in a line, and the spinning units are an example of (yarn) processing units. While the spinning machine is in operation, when a spun yarn is broken in any of the spinning units or is forcibly cut owing to a detected yarn defect such as slab, a yarn splicing carriage is run and then stopped in front of that unit. Then, a knotter, a splicer, or the like splices a lower yarn drawn from a winding package to an upper yarn of a draft device side. The Unexamined Japanese Patent Application Publication (Tokkai-Hei) 11-107078 also refers to the case in which two such yarn splicing carriages are provided.

[0003] The Unexamined Japanese Patent Application Publication (Tokkai-Hei) 6-108331 discloses a configuration in which a yarn splicing carriage and a roving yarn splicing carriage run on the same running rail. The yarn splicing carriage and the roving yarn splicing carriage are each provided with an obstacle sensor and controlled so that priority is always given to the roving yarn splicing carriage over the yarn splicing carriage in running.

[0004] The Unexamined Japanese Patent Application Publication (Tokkai-Hei) 11-107078 discloses the configuration in which the two yarn splicing carriages are provided. However, it does not refer to how the two yarn splicing carriages share processing if any spinning unit makes a yarn splicing request. On the other hand, the spinning units do not make yarn splicing requests in a specified order. The frequency at which yarn breakage occurs varies with the spinning units. Consequently, for example, yarn splicing requests may concentrate on one carriage, which thus cannot process the yarn splicing requests promptly. This reduces working efficiency to prevent the two yarn splicing carriages from being efficiently operated.

[0005] In this case, it is possible to combine the configuration in the Unexamined Japanese Patent Application Publication (Tokkai-Hei) 11-107078 with such control as gives priority to one of the two carriages as described in the Unexamined Japanese Patent Application Publication (Tokkai-Hei) 6-108331. However, with this control, the yarn splicing carriage given priority contributes to reducing the working range of the yarn splicing carriage not given priority. Consequently, the efficiency in processing yarn splicing requests decreases. This lowers the efficiency of yarn splicing carried out by the two carriages as a whole. As a result, it takes the spinning machine a long time to recover from a yarn breakage state. This lowers the production efficiency of the spinning machine.

[0006] The present invention is made in view of these circumstances. It is an object of the present invention to provide a service carriage control system that provides services using a plurality of service carriages (for example, yarn splicing carriages such as those described above) running along the same running path, wherein the system can provide prompt services and can be efficiently operated.

[0007] A description has been given of the problems to be solved by the present invention, and the description will be given of means for solving the problems as well as their effects.

Summary of the Invention

[0008] A first aspect of the present invention provides a service carriage control system configured as described above. In response to a request for a service made by each of a plurality of processing units, one of a plurality of service carriages running along the same running path is stopped at the processing unit.

[0009] Then, the processing unit is supplied with the service. A work area is pre-assigned to each service carriage. The service carriage control system comprises control means operating if a service requesting unit occurs, to perform control such that the one service carriage covering a work area to which the processing unit belongs is dispatched to the processing unit, and to control a running direction of the other service carriage covering an adjacent area that is a work area adjacent to the work area to which the processing unit belongs.

[0010] The expression "control the running direction" includes a shift from a stopped state to a running state, the reversal of the running direction of the running carriage, and maintenance of the stopped state.

[0011] This configuration controls the running directions of not only the service carriage covering the work area to which the service requesting unit belongs but also the service carriage covering the adjacent area. Consequently, the interference between the service carriages is suppressed to allow services to be generally smoothly and efficiently provided.

[0012] The service carriage control system is preferably configured as described below. The service carriage control system comprises calculating means operating if a service requesting unit occurs, to calculate a distance between a current position of the service carriage for the adjacent area and the processing unit. The control means controls the running direction of the service carriage for the adjacent area on the basis of a result of the calculation by the calculating means.

[0013] Thus, by performing the simple control for the

calculation of the distance between the position of the service carriage for the adjacent area and the service requesting unit, it is possible to perform the above control that suppresses the interference between the service carriages.

[0014] The service carriage control system is preferably configured as described below. If a service requesting unit occurs and no service requesting unit occurs in the adjacent area, the control means performs a withdrawing control that causes the service carriage for the adjacent area to run in a direction in which the service carriage moves away from the service requesting unit when a distance that is the result of the calculation by the calculating means has at most a predetermined value.

[0015] Specifically, when the distance between the position of the service carriage for the adjacent area (referred to as the "adjacent carriage" below) and the service requesting unit has at most the predetermined value, the service carriage control system performs the control that causes the adjacent carriage to run in the direction in which it moves away from the service requesting unit (withdrawing control). This ensures a distance between the service carriage running toward the service requesting unit and the adjacent carriage. Accordingly, the simple control avoids the interference between the carriages.

[0016] The service carriage control system is preferably configured as described below. The service carriage control system comprises approach sensing means for sensing that service carriages are approaching each other. If a service requesting unit occurs in an arbitrary work area, the control means dispatches an arbitrary service carriage covering a work area to which the processing unit belongs, to the processing unit. Even if the approach sensing means senses that the arbitrary service carriage running toward the service requesting unit is approaching another service carriage, when the withdrawing control is being or can be performed on the latter service carriage, the control means performs control that avoids stopping the running of the arbitrary service carriage toward the service requesting unit.

[0017] Specifically, when the withdrawing control is being or can be performed on the second service carriage, even if the approach sensing means of the running arbitrary service carriage senses the second service carriage, the control means does not stop the second service carriage with the expectation that the withdrawing control is being or is to be performed on the second service carriage. This reasonable control enables the arbitrary service carriage to reach the intended service requesting unit in a reduced time.

[0018] In the service carriage control system, preferably, even if the approach sensing means senses that the arbitrary service carriage running in the arbitrary work area toward the service requesting unit is approaching another service carriage, when the withdrawing control is being or can be performed on the latter service carriage, the control means performs control that reduces a speed at which the arbitrary service carriage runs toward the service requesting unit.

[0019] Specifically, if the approach sensing means of the arbitrary service carriage running toward the service requesting unit senses another service carriage, the arbitrary service carriage decelerates to gain time before the second service carriage completes the withdrawing control. This makes it possible to avoid collisions. Further, once the second service carriage completes the withdrawing control and the approach sensing means stops sensing the second service carriage, the arbitrary service carriage can recover from the decelerating state and return quickly to the initial running speed. Consequently, the arbitrary service carriage can reach the intended service requesting unit in a short time.

[0020] The service carriage control system is preferably configured as described below. Each service carriage is configured to be able to recognize a position of the service carriage, a position of a service requesting unit occurring in a work area covered by the service carriage, and a position of a service requesting unit occurring in a work area adjacent to the work area covered by the service carriage. The calculating means and the control means are provided in each service carriage.

[0021] This makes it possible to distribute processing among the service carriages. Consequently, control loads can be reduced.

[0022] A second aspect of the present invention provides a service carriage control system configured as described below. In response to a request for a service made by each of a plurality of processing units, one of a plurality of service carriages running along the same running path is stopped at the processing unit. Then, the processing unit is provided with the service. A work area is pre-assigned to each service carriage. Further, the service carriage control system comprises calculating means operating if a service requesting unit occurs, to calculate a distance between a position of the unit and an end of a work area to which the unit belongs, and control means for controlling a running direction of the service carriage, after end of the service, of a service carriage that provides the service for the processing unit, on the basis of a result of the calculation by the calculating means.

[0023] Thus, if a service requesting unit occurs and a service carriage is to supply a service to the service requesting unit, the running direction after the end of the service is controlled in accordance with the distance to the end of the work area to which the service requesting unit belongs. It is thus possible to suppress the interference with the service carriage for the adjacent work area. Therefore; services can be generally smoothly and efficiently supplied.

[0024] In the service carriage control system, preferably, when a distance that is the result of the calculation by the calculating means has at most a predetermined

value, the control means causes the service carriage having finished the service to run toward a center of the work area to which the service requesting unit belongs.

[0025] This serves to avoid stopping a service carriage near the boundary between work areas. It is thus possible to reliably inhibit carriages from interfering with each other near the boundary between work areas.

[0026] The service carriage control system is preferably configured as described below. Each service carriage is configured to be able to recognize a position of the service carriage, a position of a service requesting unit occurring in a work area covered by the service carriage, and a position of a service requesting unit occurring in a work area adjacent to the work area covered by the service carriage. The calculating means and the control means are provided in each service carriage.

[0027] This makes it possible to distribute processing among the service carriages. Consequently, control loads can be reduced.

Brief Description of the Drawings

[0028]

Figure 1 is a schematic plan view showing the general configuration of a spinning machine comprising a service carriage system according to an embodiment of the present invention.

Figure 2 is a block diagram showing the electrical configuration of the spinning machine.

Figure 3 is a flowchart showing the control of yarn splicing carriages.

Figure 4 is a schematic plan view showing that after the state shown in Figure 1, a first yarn splicing carriage reaches a yarn splicing requesting unit (no. 16) for yarn splicing.

Figure 5 is a schematic plan view showing that after the yarn splicing has been finished as shown in Figure 4, a spinning unit no. 18 makes a yarn splicing request.

Figure 6 is a schematic plan view showing that after the state shown in Figure 5, the first yarn splicing carriage withdraws, while a second yarn splicing carriage moves toward the yarn splicing requesting unit no. 18.

Figure 7 is a schematic plan view showing that the first yarn splicing carriage stops at the spinning unit no. 16 and that the spinning unit no. 18 makes a yarn splicing request while the second yarn splicing carriage is running near a spinning unit no. 22.

Figure 8 is a schematic plan view showing that after the state shown in Figure 7, while the second yarn splicing carriage is running toward the spinning unit no. 18, the collision preventing sensor senses the spinning unit no. 18 to decelerate the second yarn splicing carriage.

Figure 9 is a flowchart showing another example of control of the yarn splicing carriages.

Figure 10 is a schematic plan view showing that in the example of control shown in Figure 9, the first yarn splicing carriage having processed the yarn splicing request made by the spinning unit no. 16 moves toward the center of the work area.

Detailed Description of the Preferred Embodiment

[0029] A preferred embodiment of the present invention will be described below in brief with reference to the accompanying drawings.

[0030] Figure 1 shows a spinning machine 1 comprising a large number of spinning units (processing units) 3 installed in a line. The spinning machine 1 further comprises a first yarn splicing carriage 11 and a second yarn splicing carriage 12 which can run in a direction in which the spinning units 3 are arranged, and a central control device 4 that controls the spinning units 3, the first yarn splicing carriage 11 and the second yarn splicing carriage 12.

[0031] Although not shown in detail, each spinning unit 3 is mainly composed of a draft device, a spinning section, a yarn defect removing device which detects a yarn defect such as slab and which then forcibly cuts the yarn, a winding device, and the like. The spinning section spins a bundle of fibers transferred by the draft device to generate a yarn. The winding device winds the yarn to form a package.

[0032] Each of the first yarn splicing carriage 11 and second yarn splicing carriage 12 comprises running wheels (not shown in the drawings) that run on a common rail 6 laid in a main body of the spinning machine 1. The running wheels are driven by a running motor 22 to run the yarn splicing carriages 11, 12. Each of the yarn splicing carriages 11, 12 comprises a yarn splicing device such as a knotter or a splicer. If in any of the spinning units 3, the yarn is broken while a package is being formed or the yarn is cut as a result of detection of a yarn defect, either the first yarn splicing carriage 11 or the second yarn splicing carriage 12 runs to and stop in front of that spinning unit 3. The yarn splicing carriage 11 or the yarn splicing carriage 12 then splices a yarn of the package side to a yarn of the spinning device side so that the spinning unit 3 can restart spinning.

[0033] Further, each of the yarn splicing carriages 11, 12 is provided with a collision preventing sensor (approach sensing means) 7. If the collision preventing sensor 7 senses something approaching the another yarn splicing carriage, the control devices 51, 52 perform control that stops the running yarn splicing carriage or causes the yarn splicing carriage at a stop to run so as to move away from the another yarn splicing carriages.

[0034] Now, with reference to Figure 2, a description will be given of the electrical configuration of the main body of the spinning machine 1, the first yarn splicing carriage 11 and the second yarn splicing carriage 12, shown above.

[0035] As shown in Figure 2, the central control device

4, provided in the main body of the spinning machine 1, is connected via a signal line to a control device 53 provided in each of the large number of spinning units 3. This configuration enables the central control device 4 to receive, from the spinning unit 3, signals concerning the status of the spinning unit 3. The signals concerning the status of the spinning unit 3 include, for example, one indicating that the need for yarn splicing has resulted from yarn breakage (yarn splicing request signal), one indicating that the need for doffing has resulted from a full package, and one indicating that the spinning unit 3 has been stopped owing to a certain error.

[0036] As shown in Figure 1, consecutive unit numbers 1, 2, 3, ... are assigned to the spinning units 3 starting at one end of the frame of the spinning machine 1. The control device 53 of each spinning unit 3 memorizes the corresponding number. The information on the unit number is contained in a yarn splicing request signal or the like transmitted by the spinning unit 3 to the central control device 4. This enables the central control device 4 to recognize the number of a spinning unit 3 now requesting yarn splicing. The figure does not show all the spinning units 3. The spinning machine 1 according to the present invention comprises 34 spinning units 3 numbered 1 to 34.

[0037] Further, the central control device 4 is connected via signal lines to the control device 51 of the first yarn splicing carriage 11 and to the control device 52 of the second yarn splicing carriage 12. The central control device 4 can thus transmit various pieces of information to the control devices 51, 52, or conversely, acquire various pieces of information from the yarn splicing carriages 11, 12.

[0038] In addition to the yarn splicing device 21 such as a knotter or a splicer previously described, each of the two yarn splicing carriages 11, 12 comprises, for example, the running motor 22 that drives the running wheels (not shown in the drawings) of the yarn splicing carriages 11, 12, the collision preventing sensor 7, and a dog sensor 23 that senses a dog (not shown in the drawings) provided on each spinning unit 3, as shown in Figure 2.

[0039] With this electrical configuration, the control devices 51, 52 of the yarn splicing carriages 11, 12, respectively, drive the running motors 22 to run the yarn splicing carriages 11, 12 toward a requesting spinning unit 3. On the basis of the result of sensing by the dog sensor 23, the control device 51, 52 position and stop the yarn splicing carriages 11, 12 at the spinning unit 3. The control devices 51, 52 then drive the yarn splicing devices 21 for yarn splicing.

[0040] The first yarn splicing carriage 11 and the second yarn splicing carriage 12 comprise output sections 71, 72, respectively, which output signals to a sensor 61 in the spinning unit 3. With this configuration, when the first yarn splicing carriage 11 (or second yarn splicing carriage 12) arrives and stops at the intended spinning unit 3, the output section 71 (72) outputs a signal to the sensor 61 of the spinning unit 3 located opposite the stop position. Then, the spinning unit 3 corresponding to the sensor 61 having received the signal outputs a signal containing its own unit number to the control device 51 (52) of the yarn splicing carriage 11 (12) at a stop, via the central control device 4.

[0041] Thus, the yarn splicing carriage 11 (12) can recognize at which of the plurality of spinning units 3 the yarn splicing carriage 11 (12) is now stopped (that is, their own positional information). When the yarn splicing carriages 11, 12 start running from their positions, they can recognize the current running positions by counting sensing of the dog sensor 23 on the basis of the positional information.

[0042] As shown in Figure 1, work areas A1, A2 for the spinning units 3 are assigned to the two yarn splicing carriages 11, 12, respectively, so as not to overlap. Specifically, according to the present embodiment, yarn splicing operations are divided among the yarn splicing carriages, for example, the first splicing carriage 11 performs a yarn splicing operation on the spinning units 3 nos. 1 to 17, and the second yarn splicing carriage 12 performs a yarn splicing operation on the spinning units 3 nos. 18 to 34. Information on the assignment of the work areas A1, A2 is stored in the storage devices 51, 52 of the yarn splicing carriages 11, 12.

[0043] Now, a description will be given of the control of each of the yarn splicing carriages 11, 12. The control device of each of the yarn splicing carriages 11, 12 is configured as a well-known microcomputer having a CPU, a ROM, a RAM, and the like (not shown in the drawings). The ROM or the like stores a program such as the one the flow of which is shown in Figure 3. That is, hardware such as the CPU cooperates with software such as that shown in Figure 3 to allow the control devices 51, 52 to function as calculating means and control means. Exactly the same program is executed on the first yarn splicing carriage 11 and the second yarn splicing carriage 12.

[0044] In the specific description of the control below, it is assumed that the first yarn splicing carriage 11 is stopped in front of the spinning unit 3 no. 13, while the second yarn splicing carriage 12 is stopped in front of the spinning unit 3 no. 24, as shown in Figure 1.

[0045] The flow in Figure 3 will be described. The yarn splicing carriages 11, 12 first determine in step S101 whether or not a yarn splicing request has been made. Specifically, it is assumed that a yarn is broken in any (for example, no. 16) of the spinning units 3 nos. 1 to 34 and that this unit (yarn splicing requesting unit) transmits a yarn splicing request signal to the central control device 4. Then, upon receiving the yarn splicing request signal, the central control device 4 transmits a signal to the control devices 51, 52 of the yanr splicing carriages 11, 12, the signal indicating that the spinning unit 3 no. 16 is requesting yarn splicing. In step S101, the yanr splicing carriages 11, 12 checks whether or not they have received this signal. If the yarn splicing carriages

11, 12 have not received the signal, they will wait until they receive one.

[0046] If, for example, the spinning unit 3 no. 16 is requesting yarn splicing, the central control device 4 transmits the corresponding signal not only to the first yarn splicing carriage 11 but also to the second yarn yarn splicing carriage 12. Accordingly, the first yarn splicing carriage 11 can recognize the position of a yarn splicing requesting unit belonging to its work area A1. Further, the second yarn splicing carriage 12 can recognize the position of the yarn splicing requesting unit belonging to the work area A1, which is adjacent to its work area A2.

[0047] In step S101, if the signal has been received from the central control device 4, the control devices 51, 52 of the yarn splicing carriages 11, 12 analyze the signal to acquire information indicating the number of the spinning unit 3 making a yarn splicing request (the position at which the yarn splicing requesting unit is occurring). Then, the yarn splicing carriages 11, 12 check the information against the information on the assignment of their own work areas to determine whether or not the yarn splicing requesting unit belongs to their own work areas. The processing in step S102 has been described.

[0048] In this example, the yarn splicing requesting unit is the spinning unit 3 no. 16, which belongs to the work area of the first yarn splicing carriage 11 (Al; nos. 1 to 17). Accordingly, as a result of the processing in step S102, the first yarn splicing carriage 11 determines that the yarn splicing requesting unit belongs to its work area A1. The first yarn splicing carriage 11 then shifts to processing in step S103. On the other hand, as a result of the processing in step S102, the second yarn splicing carriage 12 determines that the yarn splicing requesting unit does not belongs to its work area (A2; nos. 18 to 34). The second yarn splicing carriage 12 then shifts to processing in step S110.

[0049] In step S103, the running motor 22 is driven to cause the first yarn splicing carriage 11 to start running toward the splice requesting unit. Specifically, the first yarn splicing carriage 11 starts running toward the spinning unit 3 no. 16.

[0050] After starting to run in step S103, the first yarn splicing carriage 11 runs while using the collision preventing sensor 7 to monitor whether or not it is close to the adjacent second yarn splicing carriage 12 (S104). In this example, as shown in Figure 1, the second yarn splicing carriage 12 is stopped at the position of the spinning unit 3 no. 24 and is away from the first yarn splicing carriage 11. Accordingly, the collision preventing sensor 7 does not sense the second yarn splicing carriage 12. As a result, the first yarn splicing carriage 11 continues to run (S105), stops at the spinning unit 3 no. 16, which is the yarn splicing requesting unit, and then performs a yarn splicing operation (S106). After the yarn splicing, the first yarn splicing carriage 11 returns to step S101 to wait for a new yarn splicing request while remaining at a stop.

[0051] Since the yarn splicing requesting unit is the spinning unit n. 16 and does not belong to the work area of the second yarn splicing carriage 12 (A2; nos. 18 to 34), the second yarn splicing carriage 12 shifts from step S102 to step S110 to calculate and acquire the distance between the yarn splicing requesting unit and itself. In the example shown in Figure 1, since the yarn splicing requesting unit is the spinning unit no. 16 and the second yarn splicing carriage 12 is stopped at the position of the spinning unit no. 24, the distance corresponds to | 16 - 24 | = 8 units.

[0052] Then, the second yarn splicing carriage 12 determines whether or not the distance determined is equal to three or less units (S111). If the distance is equal to three or less units, the second yarn splicing carriage 12 withdraws and moves away from the yarn splicing requesting unit a distance equal to at least four units (withdrawing control; S112). In the example shown in Figure 1, the distance is equal to eight units, that is, exceeds three units, the second yarn splicing carriage 12 executes the withdrawing movement but maintains the stopped state. The second yarn splicing carriage 12 returns to step S101 to wait for a new yarn yarn splicing request.

[0053] With the above control, as shown in Figure 1, if the spinning unit 3 no. 16 makes a yarn splicing request, the first yarn splicing carriage 11, which covers the work area A1 to which the spinning unit no. 3 belongs, runs to and stops at the spinning unit 3 no. 16. In the resulting state shown in Figure 4, a yarn splicing is carried out. The second yarn splicing carriage 12 remains at a stop.

[0054] Now, a description will be given of control performed if after the completion of a yarn splicing operation on the spinning unit 3 no. 16 in the state shown in Figure 4, yarn breakage occurs in the spinning unit 3 no. 18, which then makes a yarn splicing request, as shown in Figure 5.

[0055] A description will be given with reference to the flowchart in Figure 3.

[0056] In step S101, the first yarn splicing carriage 11 senses the generation of a yarn splicing request and proceeds to step S102. The first yarn splicing carriage 11 then checks whether or not the spinning unit 3 no. 18, requesting a yarn splicing, is located within its work area A1. In the example shown in Figure 5, the yarn splicing requesting spinning unit 3 is outside the work area of the first yarn splicing carriage 11 (A1; nos. 1 to 17).

[0057] Accordingly, the processing by the first yarn splicing carriage 11 proceeds to step S110 to calculate the distance between the yarn splicing requesting unit and the first yarn splicing carriage 11. Since the yarn splicing requesting unit is the spinning unit 3 no. 18 and the first yarn splicing carriage 11 is stopped at the spinning unit 3 no. 16, |18 - 16 | = 2 units. In step S111, the distance is determined to be equal to at least three units. Consequently, in step S112, the first yarn splicing carriage 11 withdraws and moves away from the yarn splic-

ing requesting unit a predetermined distance. In the present embodiment, the distance for withdrawing movement is predetermined to be equal to four units.

[0058] That is, the first yarn splicing carriage 11 waiting while remaining stopped at the position of the spinning unit 3 no. 16 moves away from the spinning unit 3 no. 18, that is, leftward in Figure 5, a distance equal to four units. The first yarn splicing carriage 11 then stops at the position of the spinning unit 3 no. 12 as shown in Figure 6.

[0059] The control of the second yarn splicing carriage 12 will be described. The second yarn splicing carriage 12 senses the generation of a yarn splicing request in step S101 in Figure 3. The second yarn splicing carriage 12 then checks whether or not the yarn splicing requesting unit is within its work area A2.

[0060] In this case, the yarn splicing requesting unit is the spinning unit 3 no. 18, which is included in the work area of the second yarn splicing carriage 12 (A2; nos. 18 to 34). Accordingly, as a result of the processing in step S103, the second yarn splicing carriage 12 starts to run toward the spinning unit 3 no. 18. The first yarn splicing carriage 11 stopped at the position of the spinning unit 3 no. 16 moves as previously described in the direction in which it moves away from the yarn splicing requesting unit (no. 18) at almost the same time when the second yarn yarn splicing carriage 12 starts to run (withdrawing movement in step S111). Thus, when the second yarn splicing carriage 12 runs to the yarn splicing requesting unit (no. 18), the first yarn splicing carriage 11 does not obstruct the second yarn splicing carriage 12. This withdrawing control for avoiding interference enables the second yarn splicing carriage 12 to move fast to the yarn splicing requesting unit (no. 18). This improves working efficiency.

[0061] In other words, with the above control, if a yarn splicing requesting unit (no. 18) occurs, the second yarn splicing carriage 12, which covers the work area A2 to which the yarn splicing requesting unit belongs, is dispatched to the yarn splicing requesting unit (S103 to S105). Further, the first yarn splicing carriage 11, which covers the work area (adjacent area) A1 adjacent to the work area A2 to which the unit belongs, has its running direction controlled so that the first yarn splicing carriage 11 runs away from the yarn splicing requesting unit (no. 18) when the predetermined condition (S111) is met (S112). Thus, control is preformed not only on the second yarn splicing carriage 12 for the work area A2, to which the yarn splicing requesting unit belongs, but also on the first yarn splicing carriage 11 for the adjacent work area A1. This suppresses the interference between the yarn splicing carriages 11, 12. It is thus possible to generally improve the efficiency of yarn splicing operations.

[0062] Further, if a yarn splicing requesting unit occurs, the distance between the current position of the second yarn splicing carriage 12, which covers the adjacent area A2, and the yarn splicing requesting unit is calculated (S110). Then, the running direction of the second yarn splicing carriage 12 is controlled on the basis of the result of the calculation (S111, S112). Consequently, the simple control makes it possible to suppress the interference between the yarn splicing carriages 11, 12. In particular, the result of the calculation indicates that the distance has at most a predetermined value, the first yarn splicing carriage 11 is subjected to the withdrawing control so as to move away from the yarn splicing requesting unit (S111, S112). This ensures a distance between the second yarn splicing carriage 12 dispatched to the yarn splicing requesting unit and the first yarn splicing carriage 11, as shown in Figure 6.

[0063] Now, with reference to the example shown in Figure 7, a description will be given of the control in steps S104 and S107 to S109 of the flow shown in Figure 3. In Figure 7, the first yarn splicing carriage 11 is stopped in front of the spinning unit 3 no. 16. The spinning unit 3 no. 18 makes a yarn splicing request the instant the second yarn splicing carriage 12, running toward the left end of the drawing, passes by the spinning unit 3 no. 22.

[0064] In this case, the first yarn splicing carriage 11 executes the withdrawing movement in step S112 in accordance with the flow in Figure 3. However, before the withdrawing movement is completed, the second yarn splicing carriage 12 may run to the spinning unit 3 no. 18 in accordance with the processing in step S103. The second yarn splicing carriage 12 may thus near the first yarn splicing carriage 11 and be sensed by the collision preventing sensor 7 (Figure 8). In this case, the second yarn splicing carriage 12 determines in step S104 that the collision preventing sensor 7 is sensing another yarn splicing carriage. However, if this yarn splicing carriage (first yarn splicing carriage 11) is executing or can execute the withdrawing movement, the second yarn splicing carriage 12 does not stop running to the spinning unit 3 no. 18 but only reduces its speed (S108). Then, once the first yarn splicing carriage 11 completes the withdrawing movement and the collision preventing sensor 7 stops sensing the first yarn splicing carriage 11, the second yarn splicing carriage 12 returns to the normal running (S104, S105). The second yarn splicing carriage 12 then reaches the spinning unit 3 no. 18 for yarn splicing (S106).

[0065] In other words, even if the collision preventing sensor 7 senses the second yarn splicing carriage 12 running toward the yarn splicing requesting unit, provided that the first yarn splicing carriage 11 is executing or can execute the withdrawing movement, the service carriage control system performs control such that the second yarn splicing carriage 12 is not stopped with the expectation that the first yarn splicing carriage 11 is executing or is to execute the withdrawing movement. This enables faster movement to the yarn splicing requesting unit, thus further improving the working efficiency. The second yarn splicing carriage 12 (first yarn splicing carriage 11) can determine whether or not the first yarn

splicing carriage 11 (second yarn yarn splicing carriage 12) is executing or can execute the withdrawing movement, by receiving an operational status signal for the first yarn splicing carriage 11 (second yarn splicing carriage 12) via the central control device 4. For example, if the power supply to the first yarn splicing carriage 11 is off, the second yarn splicing carriage 12 determines that the first yarn splicing carriage 11 cannot execute the withdrawing movement.

[0066] According to the present embodiment, if the first yarn splicing carriage 11 is withdrawing or can withdraw, the second yarn splicing carriage 12 reduces it running speed. The second yarn splicing carriage 12 thus waits until the withdrawing movement of the first yarn splicing carriage 11 is completed (S107, S108). Consequently, the speed is reduced to gain time to facilitate the avoidance of collision of the second yarn splicing carriage 12 against the first yarn splicing carriage 11. Further, once the withdrawing movement of the first yarn splicing carriage 11 is completed and the collision preventing sensor 7 stops sensing the first yarn splicing carriage 11, the second yarn splicing carriage 12 can recover from the reduced speed state and return quickly to the normal speed (S104, S105). The second yarn splicing carriage 12 can reach the yarn splicing requesting unit in a short time.

[0067] If the first yarn splicing carriage 11 cannot execute the withdrawing movement because it is performing a yarn splicing operation or is at a stop owing to an error, the second yarn splicing carriage 12 of course stops running in order to prevent collisions (S107, S109). Alternatively, the second yarn splicing carriage 12 may execute the withdrawing movement. Although not shown in the flow in Figure 3, even if the first yarn splicing carriage 11 is executing or can execute the withdrawing movement, if the distance between the first yarn splicing carriage 11 and the second yarn splicing carriage 12 has at most a predetermined value (for example, a value equal to four units), the service carriage control system performs control that brings the second yarn splicing carriage 12 to an emergency stop or executes the withdrawing movement. Thus, collisions are reliably avoided.

[0068] Now, another preferred example of control will be described with reference to Figure 9. The example of control in Figure 9 is obtained by adding processing in steps S113, S114 to the processing in step S106 in the example of control shown in Figure 3.

[0069] That is, in the example of control in Figure 9, if a yarn splicing requesting unit occurs near an end of the work area (for example, within three units from the end) and a yarn splicing is executed on this unit (S113), the service carriage control system performs control that stops the yarn splicing carriage after running it toward the center of its work area by a predetermined distance (for example, a distance equal to four units). The remaining part of the control is exactly the same as that in the example shown in Figure 3.

[0070] With reference to the example of control in Figure 9, a description will be given of how the running of the yarn splicing carriage 11 is controlled, for example, in the case of Figure 1. In Figure 1, when the spinning unit 3 no. 16 makes a yarn splicing request, the first yarn splicing carriage 11 runs to the spinning unit 3 no. 16 (S103 to S105 in Figure 9). As shown in Figure 4, the first yarn yarn splicing carriage 11 reaches the spinning unit 3 no. 16 for yarn splicing (S106).

[0071] Subsequently, in step S113 in Figure 9, the first yarn splicing carriage 11 determines whether or not the yarn splicing requesting unit on which it has performed a yarn splicing operation has occurred near the end of its work area A1 (specifically, whether or not the yarn splicing requesting unit is located within three units from the end). In the example shown in Figures 1 and 4, the yarn splicing requesting unit is the spinning unit 3 no. 16 and the work area A1 of the first yarn splicing carriage 11 includes the spinning units 3 nos. 1 to 17. Accordingly, the distance between the end of the work area A1 (no. 17) and the yarn splicing requesting unit (no. 16) is $|17 - 16| = 1$ unit. Thus, the distance is equal to less than three units. Therefore, the first yarn splicing carriage 11 shifts to the processing in step S114 to run toward the center of its work area A1 (in the example shown in Figure 4, toward the left end of the drawing) by a distance equal to four units. In other words, the first yarn splicing carriage 11 performs a yarn splicing operation on the spinning unit 3 no. 16 and then immediately runs leftward in Figure 4 by the distance equal to four units. Then, as shown in Figure 10, the first yarn splicing carriage 11 stops in front of the spinning unit 3 no. 12.

[0072] As described above, in the example of control in Figure 9, if a yarn splicing requesting unit occurs near an end of the work area and the corresponding yarn splicing carriage performs a yarn splicing operation on the unit, then after the yarn splicing operation, the yarn splicing carriage immediately moves toward the inside of its work area regardless of whether or not a yarn splicing request is occurring in the adjacent work area. Consequently, it is possible to prevent the yarn splicing carriages 11, 12 from stopping near the boundary between the work area A1 and the work area A2 as shown in Figure 10 except when a yarn splicing request is made by the spinning unit 3 located near the boundary between the work area A1 and the work area A2. Accordingly, in Figure 10, if, for example, the spinning unit 3 no. 18 makes a yarn splicing request, it is possible to simply dispatch the second yarn splicing carriage 12 to the spinning unit 3 no. 18 without the need to withdraw or move the first yarn splicing carriage 11. In other words, the first yarn splicing carriage 11 is pre-withdrawn to the center of the work area A1. This reduces the need to decelerate the second yarn splicing carriage 12 (step S108) as shown in Figure 8. As a result, the second yarn splicing carriage 12 can reach the yarn splicing requesting unit in a short time.

[0073] In other words, with the above control, if a yarn

splicing requesting unit (no. 16) occurs, the distance between the position of the unit and the end of the work area A1 to which the unit belongs is calculated. Then, on the basis of the result of the calculation, the service carriage control system controls the running direction, after the end of the yarn splicing, of the first yarn splicing carriage 11, which executes yarn splicing on the yarn splicing requesting unit, spinning unit 3 no. 16. This makes it possible to suppress the interference with the second yarn splicing carriage 12 for the adjacent work area A2. Further, when the distance corresponding to the result of the calculation has at most the predetermined value, the first yarn yarn splicing carriage 11 is run toward the center of the work area A1 after the yarn splicing operation has been finished. This avoids stopping the first yarn splicing carriage 11 near the boundary of the work area A1. Consequently, the interference can be reliably inhibited.

[0074] The preferred embodiment of the present invention has been described. However, the above embodiment may be changed as described below.

(1) In step S111 in Figure 3 and Figure 9, when the distance between the yarn splicing requesting unit and the yarn splicing carriage is equal to three or less units, the withdrawing movement is executed in step S112. However, the distance condition for the withdrawing movement is not limited to the three units. An appropriate condition may be specified taking into account the lengths of the yarn splicing carriages 11, 12 in the running direction, the sensible distance of the collision preventing sensor 7, or the like. Likewise, for the distance of the withdrawing movement in step S112, an appropriate withdrawing movement distance may be specified taking into account the sensible distance of the collision preventing sensor 7 or the like, so as to avoid obstructing another carriage.

(2) The following may also be determined taking into account the lengths of the yarn splicing carriages 11, 12 in the running direction, the sensible distance of the collision preventing sensor 7, or the like: the number of units from the end of the work area on the basis of which the yarn splicing carriage determines that the yarn splicing requesting unit is near the end of the work area in step S113 in Figure 9. This also applies to the distance over which the yarn splicing carriage runs toward the center of the work area in step S114.

(3) The distance between the yarn splicing requesting unit and the yarn splicing carriage may be measured and conditioned, for example, in centimeter units instead of using the distance in terms of spinning units. Further, in order to determine the positions of the yarn splicing carriages 11, 12, it is possible to provide each of the yarn splicing carriages 11, 12 with, for example, a rotary encoder to obtain information from the encoder instead of using the signal from the central control device 4 as well as the dog sensor 23 as described above. In this case, the number of pulses output by the rotary encoder may be used as a distance unit. The predetermined distance (the predetermined number of units) used for the above control may be set by, for example, causing the central control device 4 to set a distance and transmitting and storing the information to and in the control devices 51, 52.

(4) The service carriage control system performs control such that the yarn splicing carriages 11, 12 carries out yarn splicing on the yarn splicing requesting unit and are then stopped and stand by according to the above embodiment. This is advantageous in that energy is not wasted. This control is also excellent in the following point. After yarn breakage has occurred once in a spinning unit 3, this spinning unit 3 is likely to frequently undergo yarn breakage. The above control promptly deals with this case without the need to move the yarn splicing carriages.

However, the service carriage control system may perform control such that the yarn splicing carriages 11, 12 runs along the work areas A1, A2, respectively, after the yarn splicing operation. In this case, when a yarn splicing requesting unit occurs in the adjacent work area and the distance between the yarn splicing requesting unit and the current running position of the yarn splicing carriage is equal to three or less units (S111), if the yarn splicing carriage is running toward the yarn splicing requesting unit, the service carriage control system may perform control that reverses the running direction to execute the withdrawing movement (S112).

(5) The central control device 4 of the spinning machine 1 can be used in place of the control devices 51, 52 of the yarn splicing carriages 11, 12 to execute the flows shown in Figures 3 and 9, perform the control. Specifically, for example, in Figure 5, upon receiving a yarn splicing requesting signal from the spinning unit 3 no. 18, the central control device 4 sends a signal to the control device 52 of the second yarn splicing carriage 12 so as to dispatch the second yarn splicing carriage 12 to the spinning unit 3. The central control device 4 also calculates the distance between the position of the first yarn splicing carriage 11 and the yarn splicing requesting unit (no. 18). When the result of the calculation indicates three or less units, the central control device 4 sends a signal to the control device 51 of the first yarn splicing carriage 11 so as to run the first yarn splicing carriage 11 toward the left end of Figure 5 by a distance equal to, for example, four units.

In this case, the operation described below may be performed instead of providing each of the yarn splicing carriages 11, 12 with the collision preventing sensor 7. The central control device 4 constantly

acquires the positions of the yarn splicing carriages 11, 12 to calculate the distance between them. Then, in step S104 in Figure 3, when the distance has at most a predetermined value, the central control device 4 may determine that the yarn splicing carriages 11, 12 are approaching each other. In this case, the central control device 4 also functions as approach sensing means.

However, the above embodiment is more advantageous in that loads on the central control device 4 can be reduced: in the above embodiment, the control devices 51, 52 of the yarn splicing carriages 11, 12, so to speak, autonomously perform the withdrawing control and the like. This effect is notably marked in a large-scale spinning machine comprising a large number of yarn splicing carriages.

(6) A plurality of yarn splicing carriages 11, 12 must be provided along the same running path (in the above embodiment, the rail 6). However, the number of yarn splicing carriages may be three instead of two. In this case, the spinning units 3 nos. 1 to 34 are allotted to three work areas. Further, in the above embodiment, there are 34 spinning units 3 numbered from 1 to 34. However, there may be more or less spinning units 3.

(7) The above embodiment relates to a service carriage control system for a yarn splicing operation (yarn splicing service) in a spinning machine. However, the present invention is not limited to this but is applicable to, for example, a doffing operation in a spinning machine. Further, the present invention is not limited to a textile machine such as a spinning machine but is applicable to service carriage control systems in general which are used for a plurality of processing units that request a certain service operation.

Claims

1. A service carriage control system that operates in response to a request for a service made by each of a plurality of processing units, to stop one of a plurality of service carriages running along the same running path, at the processing unit, the system then supplying the processing unit with the service, the system being **characterized in that**:

a work area is pre-assigned to each service carriage, and

the system comprises:

control means operating if a service requesting unit occurs, to perform control such that the one service carriage covering a work area to which the processing unit belongs is dispatched to the processing unit, and to control a running direction of the other service carriage covering an adjacent area that is a work area adjacent to the work area to which the processing unit belongs.

2. A service carriage control system according to Claim 1, **characterized by** comprising calculating means operating if a service requesting unit occurs, to calculate a current position of the service carriage for the adjacent area and a distance to the processing unit, and

in that said control means controls the running direction of the service carriage for the adjacent area on the basis of a result of the calculation by the calculating means.

3. A service carriage control system according to Claim 2, **characterized in that** if a service requesting unit occurs and no service requesting unit occurs in the adjacent area,

the control means performs a withdrawing control that causes the service carriage for the adjacent area to run in a direction in which the service carriage moves away from the service requesting unit when a distance that is the result of the calculation by the calculating means has at most a predetermined value.

4. A service carriage control system according to Claim 3, **characterized by** comprising approach sensing means for sensing that service carriages are approaching each other, and

in that if a service requesting unit occurs in an arbitrary work area, the control means dispatches an arbitrary service carriage covering a work area to which the processing unit belongs, to the processing unit, and

even if the approach sensing means senses that the arbitrary service carriage running toward the service requesting unit is approaching another service carriage, when the withdrawing control is being or can be performed on the latter service carriage, said control means performs control that avoids stopping the running of the arbitrary service carriage toward the service requesting unit.

5. A service carriage control system according to Claim 4, **characterized in that** even if the approach sensing means senses that the arbitrary service carriage running in the arbitrary work area toward the service requesting unit is approaching another service carriage, when the withdrawing control is being or can be performed on the latter service carriage, the control means performs control that reduces a speed at which the arbitrary service carriage runs toward the service requesting unit.

6. A service carriage control system according to any one of Claims 2 to 5, **characterized in that** each service carriage is configured to be able to recognize a position of the service carriage, a position of a service requesting unit occurring in a work area covered by the service carriage, and a position of a service requesting unit occurring in a work area adjacent to the work area covered by the service carriage, and

the calculating means and the control means are provided in each service carriage.

7. A service carriage control system that operates in response to a request for a service made by each of a plurality of processing units, to stop one of a plurality of service carriages running along the same running path, at the processing unit, the system then providing the processing unit with the service, the system being **characterized in that**:

a work area is pre-assigned to each service carriage, and

the system comprises:

calculating means operating if a service requesting unit occurs, to calculate a distance between a position of the unit and an end of a work area to which the unit belongs; and

control means for controlling a direction of running, after end of the service, of a service carriage that provides the service for the processing unit, on the basis of a result of the calculation by the calculating means.

8. A service carriage control system according to Claim 7, **characterized in that** when a distance that is the result of the calculation by the calculating means has at most a predetermined value, the control means causes the service carriage having finished the service to run toward a center of the work area to which the service requesting unit belongs.

9. A service carriage control system according to Claim 7 or Claim 8, **characterized in that** each service carriage is configured to be able to recognize a position of the service carriage, a position of a service requesting unit occurring in a work area covered by the service carriage, and a position of a service requesting unit occurring in a work area adjacent to the work area covered by the service carriage, and the calculating means and the control means are provided in each service carriage.

FIG. 1

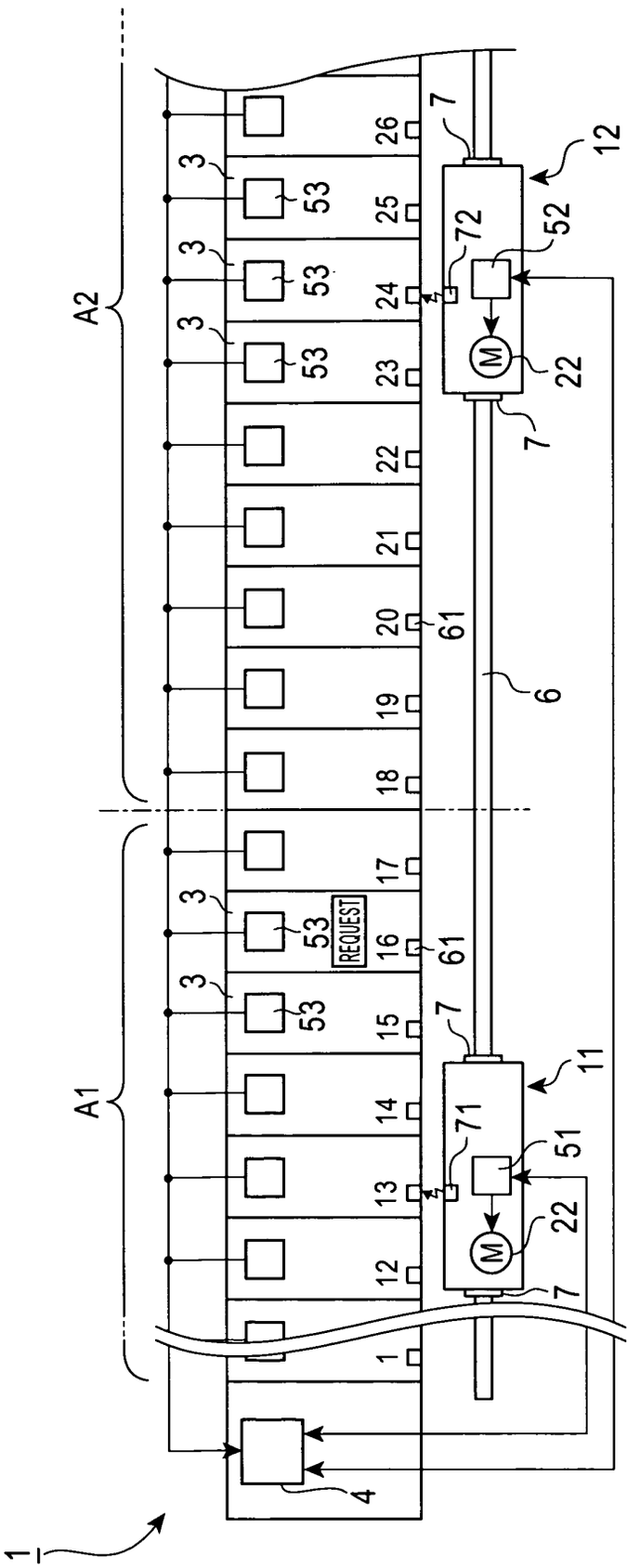

FIG. 2

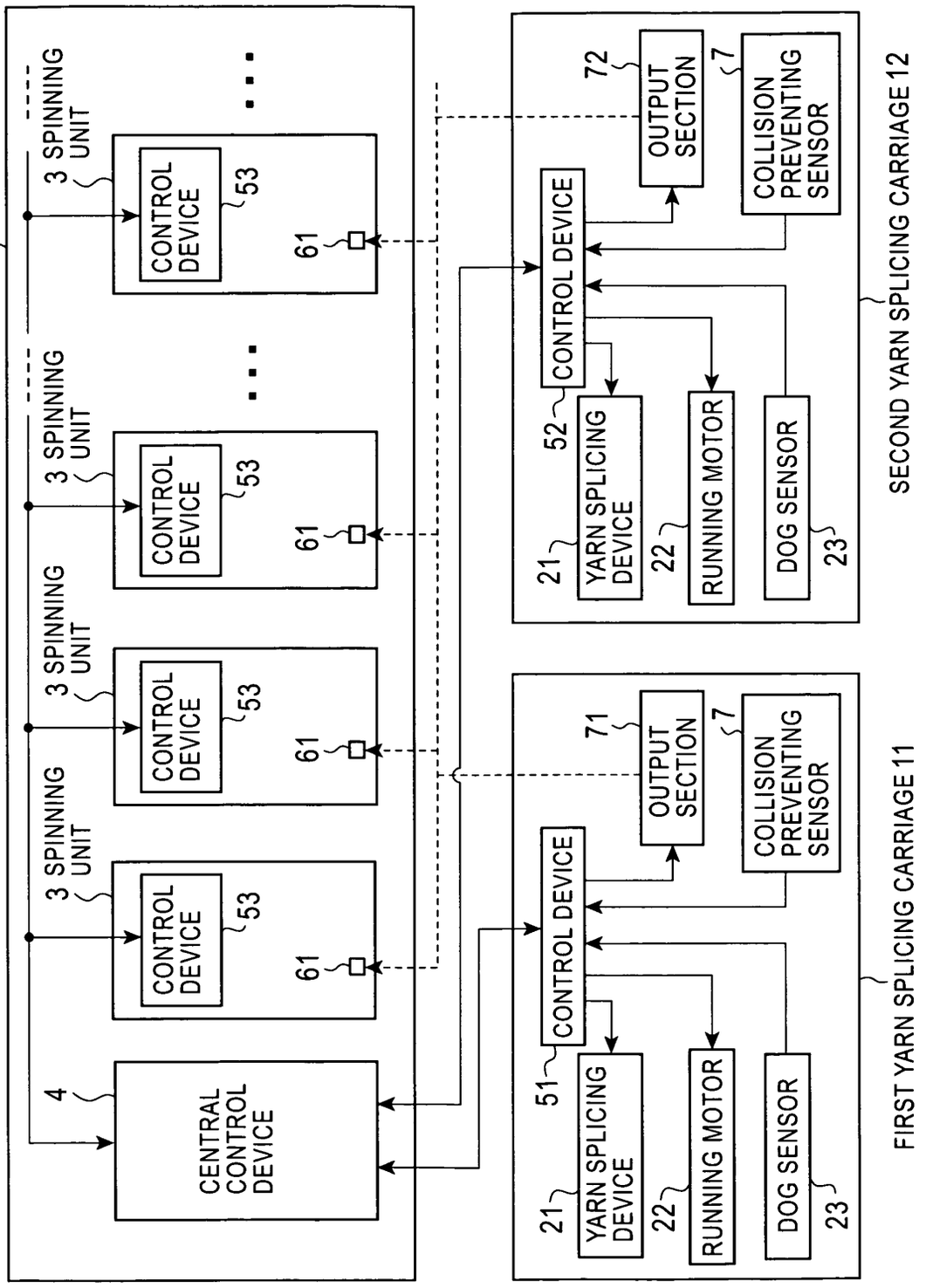
MAIN BODY OF SPINNING MACHINE 1
3 SPINNING UNIT
CONTROL DEVICE
53
61
4
CENTRAL CONTROL DEVICE
FIRST YARN SPLICING CARRIAGE 11
SECOND YARN SPLICING CARRIAGE 12
51
52
71
72
7
OUTPUT SECTION
COLLISION PREVENTING SENSOR
21
YARN SPLICING DEVICE
22
RUNNING MOTOR
23
DOG SENSOR

FIG. 3

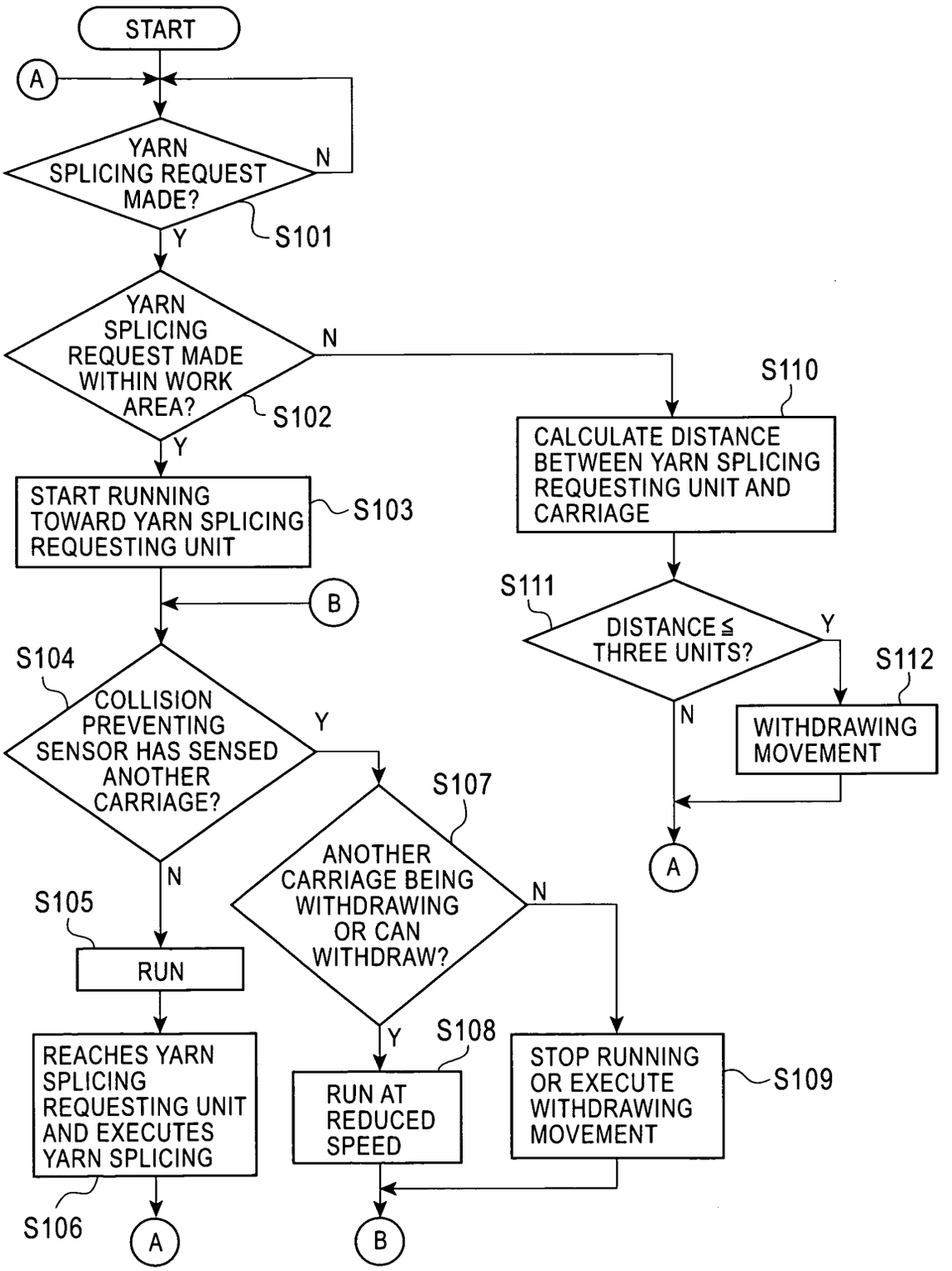
START
A
YARN SPLICING REQUEST MADE?
N
Y
S101
YARN SPLICING REQUEST MADE WITHIN WORK AREA?
N
Y
S102
START RUNNING TOWARD YARN SPLICING REQUESTING UNIT
S103
B
S104
COLLISION PREVENTING SENSOR HAS SENSED ANOTHER CARRIAGE?
Y
N
S105
RUN
REACHES YARN SPLICING REQUESTING UNIT AND EXECUTES YARN SPLICING
S106
A
S107
ANOTHER CARRIAGE BEING WITHDRAWING OR CAN WITHDRAW?
N
Y
S108
RUN AT REDUCED SPEED
B
S110
CALCULATE DISTANCE BETWEEN YARN SPLICING REQUESTING UNIT AND CARRIAGE
S111
DISTANCE ≦ THREE UNITS?
Y
N
S112
WITHDRAWING MOVEMENT
A
STOP RUNNING OR EXECUTE WITHDRAWING MOVEMENT
S109

FIG. 4

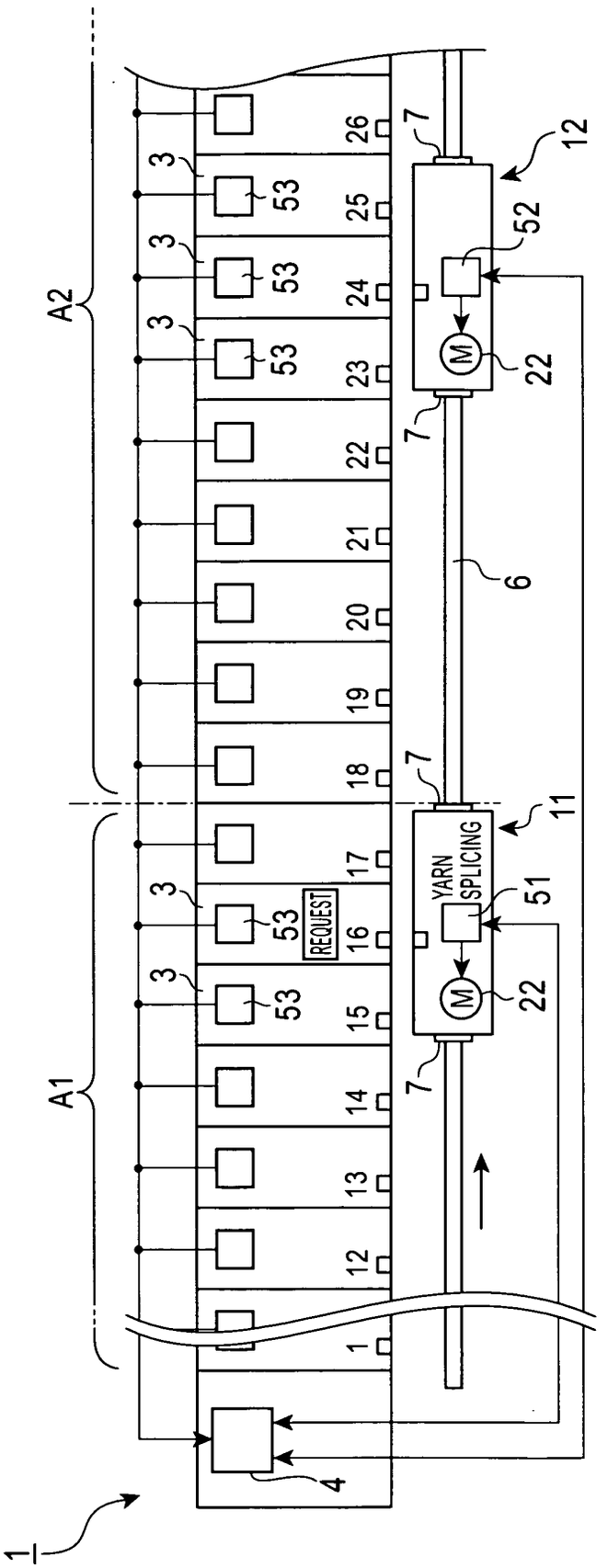
A2
A1
1
4
3
53
REQUEST
YARN SPLICING
51
52
6
7
11
12
22
M
1
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

FIG. 5

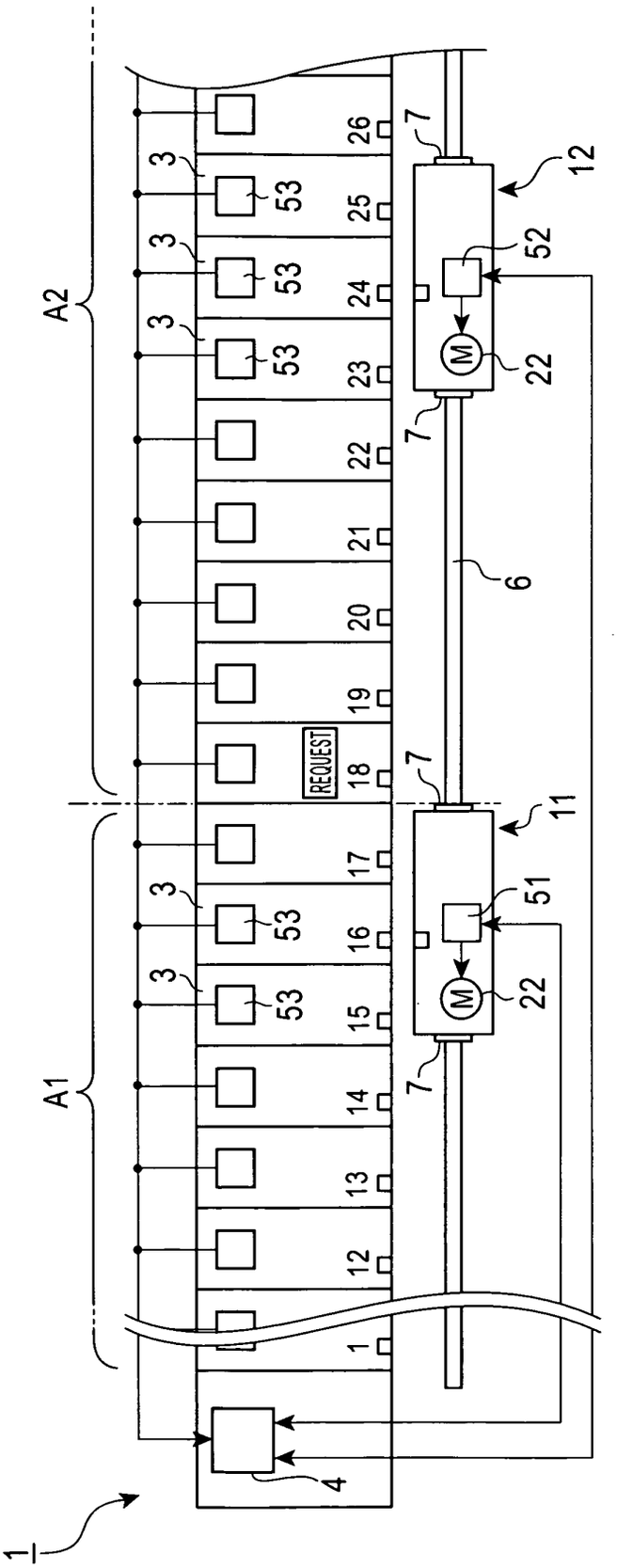

FIG. 6

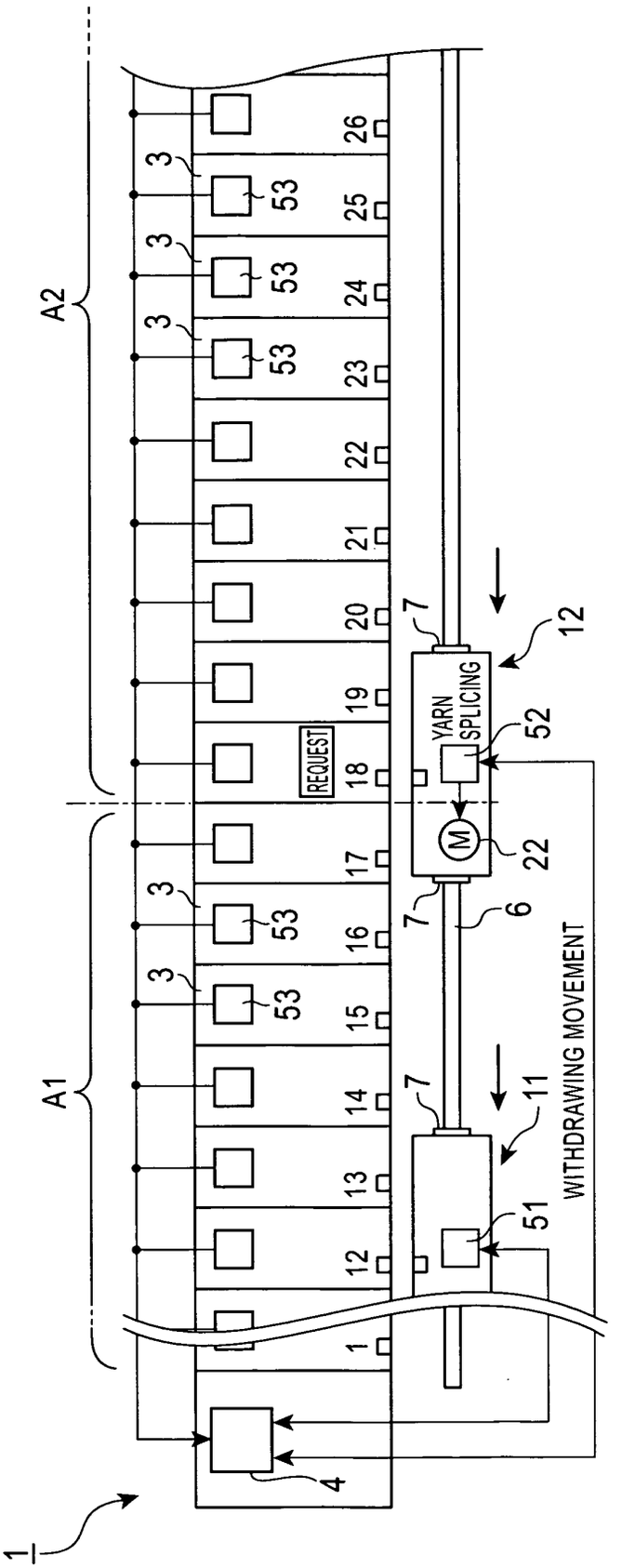
A2
A1
REQUEST
YARN SPLICING
WITHDRAWING MOVEMENT
1
3
4
6
7
11
12
22
51
52
53

FIG. 7

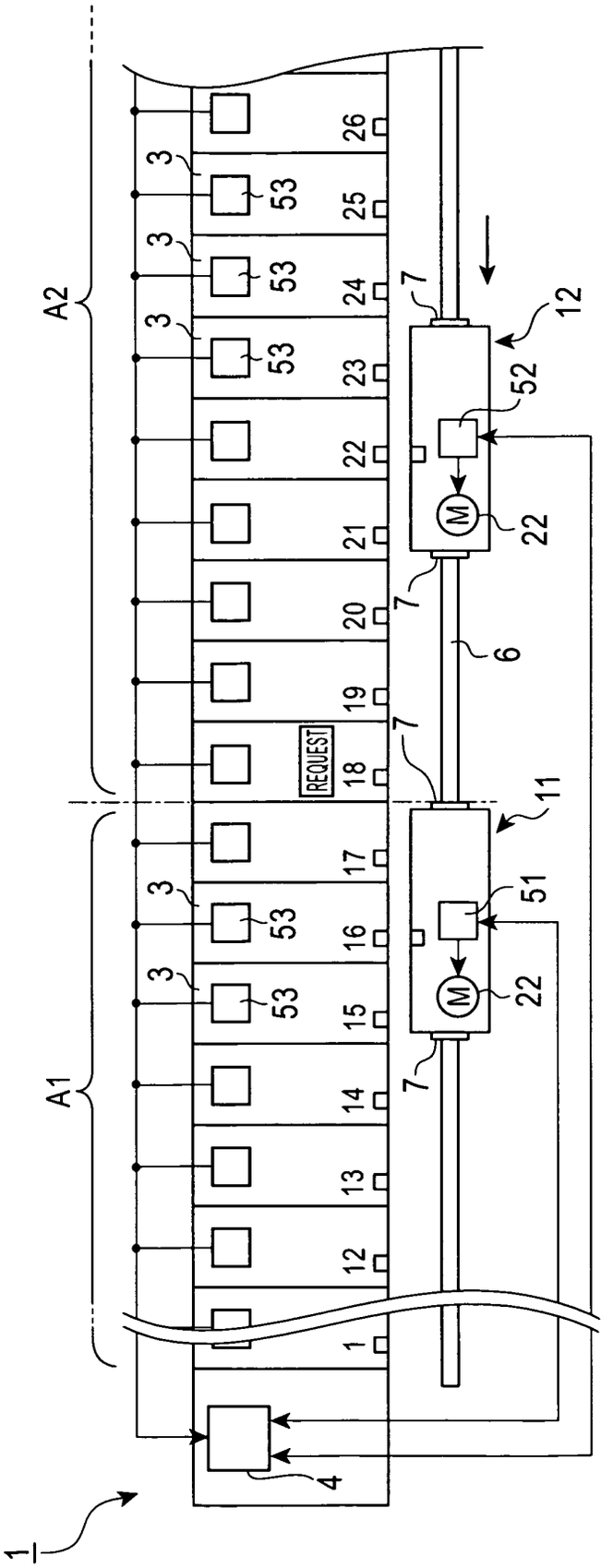

FIG. 8

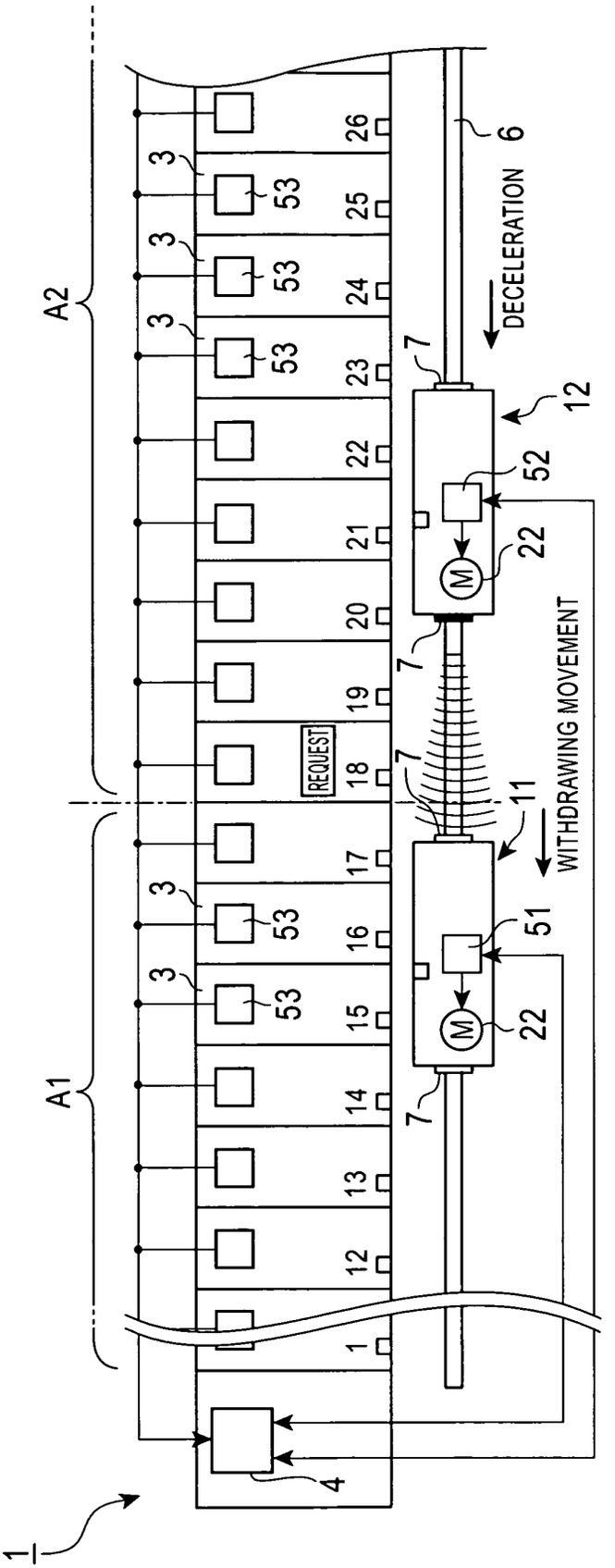
A1
A2
1
4
6
7
11
12
22
26
25
24
23
21
20
19
18
17
16
15
14
13
12
1
3
51
52
53
M
REQUEST
DECELERATION
WITHDRAWING MOVEMENT

FIG. 9

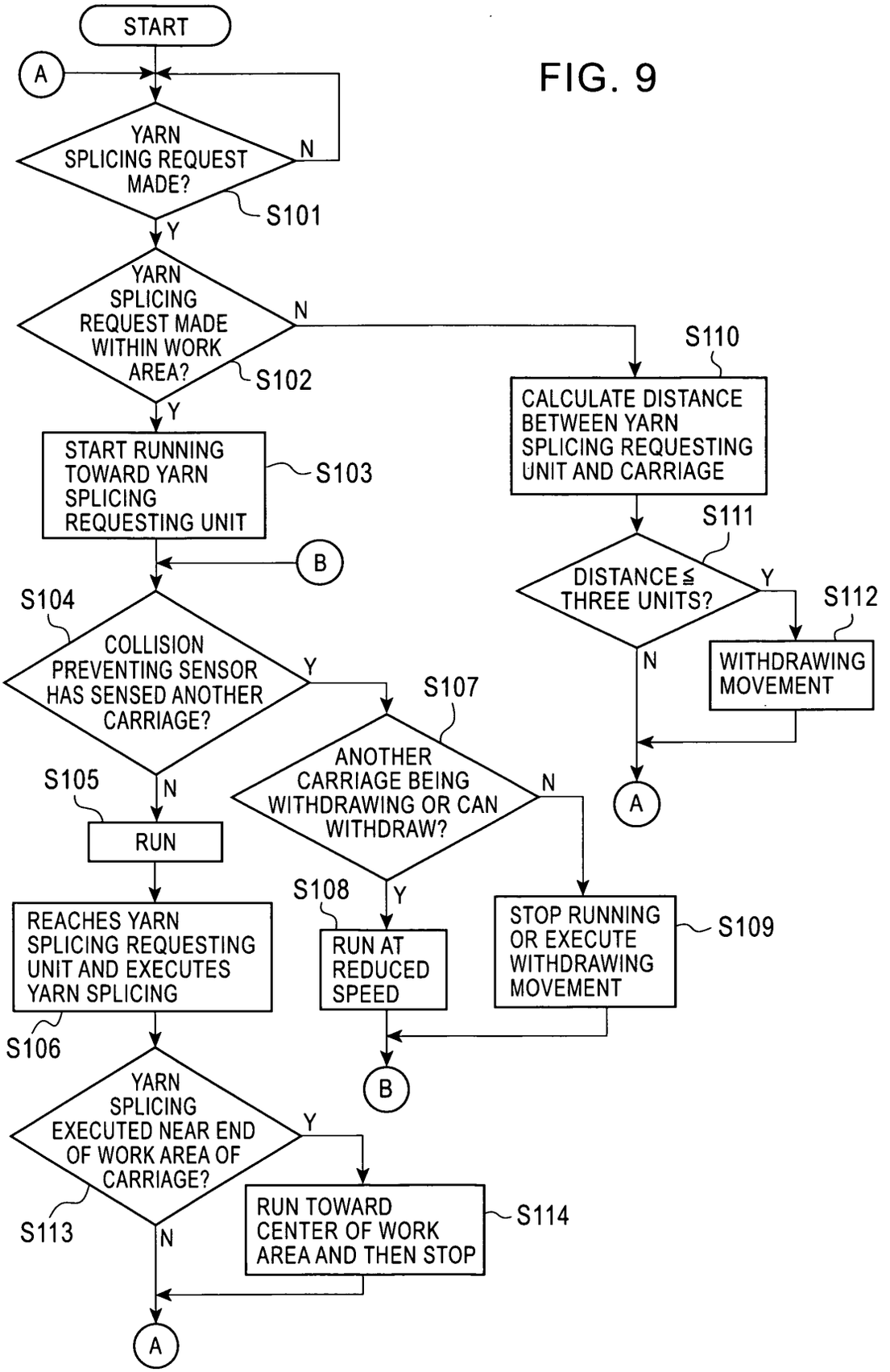
START
A
YARN SPLICING REQUEST MADE?
N
S101
Y
YARN SPLICING REQUEST MADE WITHIN WORK AREA?
N
S102
Y
START RUNNING TOWARD YARN SPLICING REQUESTING UNIT
S103
B
S104
COLLISION PREVENTING SENSOR HAS SENSED ANOTHER CARRIAGE?
Y
S107
N
S105
RUN
REACHES YARN SPLICING REQUESTING UNIT AND EXECUTES YARN SPLICING
S106
ANOTHER CARRIAGE BEING WITHDRAWING OR CAN WITHDRAW?
N
Y
S108
RUN AT REDUCED SPEED
STOP RUNNING OR EXECUTE WITHDRAWING MOVEMENT
S109
B
YARN SPLICING EXECUTED NEAR END OF WORK AREA OF CARRIAGE?
Y
S113
N
RUN TOWARD CENTER OF WORK AREA AND THEN STOP
S114
A
S110
CALCULATE DISTANCE BETWEEN YARN SPLICING REQUESTING UNIT AND CARRIAGE
S111
DISTANCE ≦ THREE UNITS?
Y
S112
WITHDRAWING MOVEMENT
N
A

FIG. 10