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## (54) SERVICE ROBOT OF A RING SPINNING MACHINE, RING SPINNING MACHINE AND A METHOD FOR CONTROLLING GROUPS OF HANDLING MEANS

(57) The invention relates to a service robot of a ring spinning machine, arranged displaceably along a row of spinning stations with an option of stopping at a selected spinning station requiring a service operation, whereby the service robot is provided with groups of handling means (3, 4, 5, 6) coupled to drives. The service robot (1) is arranged as a vertical frame, which is provided with at least two vertical linear guides (2, 18, 20, 21), whereby at least one of them is associated with at least two movable groups (3, 4, 5, 6) of handling means to perform service operations at the spinning station. The invention also relates to a ring spinning machine with a service robot, which is arranged displaceably along a row of spinning stations with an option to stop at a selected spinning station requiring a service operation. In addition, the invention relates to a method for controlling a service robot or its spinning means.

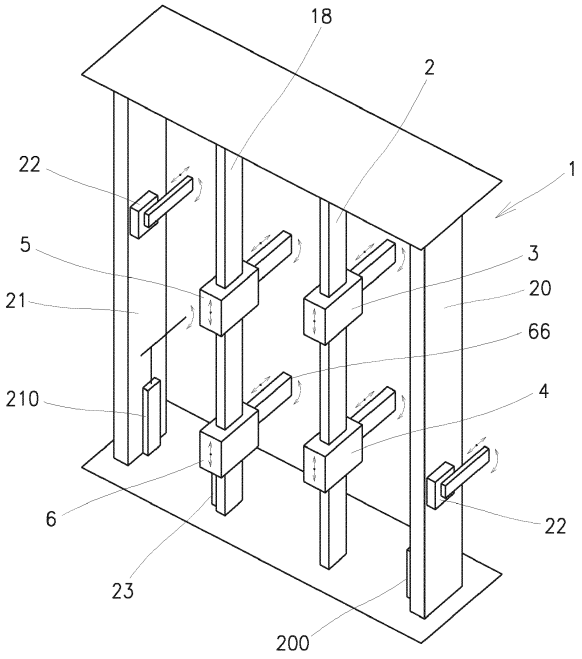


Fig. 3

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## Description

### Field of the invention

**[0001]** The invention relates to a service robot of a ring spinning machine, arranged displaceably along a row of spinning stations with an option of stopping at a selected spinning station, whereby the service robot is provided with groups of handling means coupled to drives.

**[0002]** The invention also relates to a ring spinning machine with a service robot, which is arranged displaceably along a row of spinning stations with an option to stop at a selected spinning station requiring a service operation.

**[0003]** In addition, the invention relates to a method for controlling groups of handling means of a service robot of a ring spinning machine, in which the motion of the groups of handling means is controlled in the vertical direction.

### Description of related art

**[0004]** Ring spinning machines comprise a row of spinning stations arranged next to each other, each of which comprises a roving drafting device, from which the processed fiber roving is carried to a twisting device, from which the produced yarn is withdrawn and wound in a winding device on a tube carried by a spindle, which results in cop formation, i.e., the formation of a tube with a package.

**[0005]** If a yarn manufacturing process is interrupted, e.g., due to a yarn break, the yarn production at the respective spinning station must be resumed. When the spinning process is resumed at the spinning station, after interrupting the spinning process, the roving feeding rollers of the drafting device are stopped, for example, or the drafting device is running and fibers from the roving are sucked into the waste, etc. Afterwards, the motion of a traveller on a ring is terminated, which is usually recorded by a sensor of the motion of the traveller. Subsequently, it is necessary to detect the end of the yarn being wound on the cop package, unwind the yarn from the package, put it progressively through a traveller, a balloon limiter, and a guide eyelet and finally bring the yarn end between the end rollers of the drafting device in such a manner that during the spinning resumption it is joined to the end of the roving, thereby preparing the spinning station for the renewal of the process of the yarn production. All these service operations are performed during constant reversible vertical motion of a ring bench and a balloon limiter carrier, because the other spinning stations continue producing the yarn.

**[0006]** In general, current ring spinning machines are largely hand-operated for several reasons. One reason is the limited workspace for the service mechanisms of a service robot because there is only a short distance between the spinning stations (70 and 75 mm). Another reason is the difficulty in solving the functional activities of the service mechanisms without spatial and temporal limitation of the service mechanisms in the already limited workspace. Last but not least, manual service is advantageous in many parts of the world also for price reasons.

**[0007]** However, known are various configurations of an automatic service robot for operating spinning stations on a ring spinning machine, which perform service operations at a spinning station when resuming the working process after yarn breakage.

**[0008]** For example, EP 0 394 671 A2 discloses using a service robot to resume the working process after a break of the produced yarn at a spinning station of a ring spinning machine, whose handling means are arranged on separate clamping elements and their transfer to the working position is performed by an associated drive member, which causes a higher weight of the entire service robot and increases its cost.

**[0009]** DD3000111 describes an embodiment, wherein the vertical motion of handling means is performed by a toothed belt on a vertical guide arranged in a housing of a service robot, the vertical guide and the toothed belt being used to move only one service mechanism, which increases the complexity, weight and cost of the service robot.

### Brief summary of the invention

**[0010]** The aim of the invention is therefore to eliminate or at least reduce the disadvantages of the background art.

**[0011]** The aim of the invention is achieved by a service robot for the automatic service of a spinning station of a yarn manufacturing ring spinning machine according to the preamble of claim 1, characterized in that the service robot is arranged as a vertical frame provided with at least two vertical linear guides, whereby at least one of them is associated with at least two movable groups of handling means for performing service operations at the spinning station.

**[0012]** The principle of the method for controlling the service robot consists in that at least two groups of handling means can move simultaneously along a common vertical guide, while the same or varying distance is maintained between them.

**[0013]** The advantage of this solution is an economical spatial arrangement of the service robot, which allows service operations on ring spinning machines in which the spinning stations are arranged with very small spaces between each other. Furthermore, it leads to saving drive means and shortens the time needed for performing service operations at a spinning station of a ring spinning machine. Another advantage is the reduction in manufacturing costs of the service robot. This arrangement allows to displace the handling means directly or by means of another group of handling means, dependently or independently of each other, according to current and considerably variable needs. When performing their service activities, the handling means are displaced directly or indirectly by drive means, which are associated

with a vertical linear guide of the service robot or which may be (not necessarily) associated with a group of handling means or the handling means are displaced by a movable member which is arranged on the frame of the ring spinning machine. The same drive means displace the handling means from their basic or rest position to their working position, and, vice versa, from their working position to their basic or rest position, thereby creating sufficient working and handling space for the handling means which are currently in operation. The resulting motion of the group of handling means may result from the action of one drive means or from the combination of the action of more than one drive means. Therefore, the vertical position of the group of handling means can be varied relative to the spinning station being serviced or it is possible to vary the relative position of the groups of handling means.

**[0014]** Preferably, the vertical linear guides are provided with an endless belt, which is wrapped at one end of the guide around a drive pulley and at the other end of the guide is wrapped around a freely rotatable pulley, whereby attached to the belt is a carrier of one group of handling means and, in addition, at least one other group of handling means is movably and disconnectably coupled to the belt.

**[0015]** Preferably, this at least one other group of handling means is coupled to the belt movably and disconnectably by a drive pulley, which is coupled to a rotary drive, whereby a pair of freely rotatable guide pulleys is assigned to the drive pulley, whereby the guide pulleys are arranged relative to the drive pulley to ensure the wrapping of the drive pulley by the belt.

**[0016]** Preferably, at least one of the groups of handling means is provided with means for synchronous vertical reciprocating motion along with the motion of a ring bench of the ring spinning machine.

**[0017]** Preferably, at least one of the groups of handling means comprises a backstop for laying the group of handling means on the ring bench.

**[0018]** Preferably, the group of handling means with means for synchronous vertical reciprocating motion together with the motion of the ring bench has weight and mechanical resistance of its guidance on the vertical linear guide lower than is the vertical loadability of the ring bench without affecting the drive and/or the motion of the ring bench.

**[0019]** Preferably, on the frame is fixed at least one auxiliary group of handling means, which is independent of the other groups of handling means.

**[0020]** Preferably, at least one of the groups of handling means displaceably mounted on the vertical linear guides is provided with at least one position sensor.

**[0021]** Preferably, the movable groups of handling means are for motion on the vertical linear guides coupled to drives formed by stepper motors and/or linear motors.

**[0022]** Preferably, the drives of the movable groups of handling means for motion on the vertical linear guides are provided with means of controlling their speed and/or position and/or direction of motion and are coupled to the control device.

**[0023]** Preferably, the handling means of the groups of the handling means are coupled to mechanical and/or pneumatic and/or electronic driving elements.

**[0024]** The aim of the invention is as well achieved by a ring spinning machine with a mentioned service robot, characterized in that the service robot arranged displaceably along a row of spinning stations can be stopped at a selected spinning station which requires a service operation.

**[0025]** Preferably, the ring spinning machine comprises a ring bench, and is characterized in that

- the service robot is arranged as a vertical frame, which is provided with at least two vertical linear guides, at least one of which is associated with at least two movable groups of handling means to perform service operations at the spinning station;
- at least one of the groups of handling means is provided with means for synchronous vertical reciprocating motion along with the motion of a ring bench of the ring spinning machine
- the means for the synchronous vertical reciprocating motion of the group of handling means together with the ring bench comprise a backstop to be laid on the ring bench and
- the group of handling means with means for synchronous vertical reciprocating motion together with the motion of the ring bench has weight and mechanical resistance of its guidance on the vertical linear guidelower than is the vertical loadability of the ring bench without affecting the drive and/or the motion of the ring bench.

**[0026]** Preferably, the ring spinning machine contains at least one parking position for the service robot, the robot is stoppable on the parking position of the robot and the parking position is situated outside the spinning stations at the beginning of the machine and/or at the end of the machine and/or at the drive unit of the machine situated between spinning stations.

**[0027]** The aim of the invention is as well achieved by a method of controlling groups of handling means of the service robot of a inventive ring spinning machine, in which the motion of the groups of handling means is controlled in the vertical direction, characterized in that

- at least two groups of handling means move simultaneously along a common vertical guide and maintain the same distance between them; or
- one of at least two groups of handling means is moving along the common vertical guide, and the other group of handling means stops; or
- at least two groups of handling means move along the common vertical guide with varying their mutual distance; or
- at least two groups of handling means move along

the common vertical guide, wherein one of them moves by the action of the ring bench synchronously together with the movable ring bench.

**Brief description of the drawings**

**[0028]** The invention is schematically represented in the drawing, wherein

**Fig. 1** shows an arrangement of a service robot,

**Fig. 2** shows an arrangement of handling means and drive means on a vertical linear guide with respect to the spinning station of a ring spinning machine,

**Fig. 3** shows an example of an arrangement of handling means and drive means on a pair of vertical linear guides.

**Detailed Description of the invention**

**[0029]** The invention will be described with reference to an exemplary embodiment of a service robot 1 of a ring spinning machine producing yarn, whereby the machine comprises a row of identical spinning stations arranged next to each other, the service robot 1 being arranged displaceably along the row of spinning stations with an option of stopping at a selected spinning station requiring a service operation.

**[0030]** The spinning station is principally well-known and therefore the entire spinning station will only be described in a simplified manner. Those parts, elements and nodes of the spinning station that are of significance to the present invention will be described in greater detail.

**[0031]** Each spinning station of a ring spinning machine comprises an unillustrated roving drafting device, below which a twisting and winding device is arranged. The roving is fed from an unillustrated supply package to the drafting device, behind which the yarn being formed passes through a guide eyelet, a balloon limiter and then through a traveller circulating around the circumference of a ring mounted in a holder on a ring bench 12, whereupon after the passage through the traveller, the produced yarn is wound on a tube which is placed on a rotating spindle 13, which results in cop formation. The package of yarn is formed on the tube by a continuous reversible vertical motion of the ring bench 12 in the directions C and D on the guide 14, see Fig. 2, in the interaction with the traveller, which circulates on the upper part of the ring, whereby due to the traveller being delayed behind the revolutions of the spindle 13 a twist is created on the yarn, thereby changing the processed roving into the yarn with the desired properties. The spindle is usually driven in its lower part by means of a flat belt driven by a drive shaft.

**[0032]** When a yarn break occurs during winding on the bobbin, this fact is recorded by a sensor at the spinning station and the information is passed to a control unit of the machine, which after the evaluation of the information from other spinning stations and the information from the service robot 1 makes a decision about transferring the service robot 1 to the spinning station to perform a service operation. The service operation consists of several service steps following one another, performed parallel to one another, etc. First, the rotating spindle 13 with the bobbin stops, the bobbin is either removed from the machine and moved closer to the service robot 1 to find subsequently the broken yarn or it remains at the spinning station, whereupon the end of the broken yarn is detected on the package of the bobbin. After detecting the yarn end, a required length of yarn is wound for a yarn reservoir, whereby if the bobbin has been removed from the machine, it is now returned to the machine and placed on the spindle. The yarn end is threaded into the traveller, through the balloon limiter and then through the guide eyelet and is inserted between the end rollers of the drafting device so that this yarn end is brought into contact with the end of the roving clamped by the end rollers of the drafting device while, at the same time, the winding of the yarn on the bobbin is started.

**[0033]** The device according to the present invention is to ensure that these and other service steps unspecified herein are performed with the necessary synergy of the service mechanisms moving along the linear and/or spatial paths at the spinning stations being served in the space, which is extremely limited due to the small spacing between the spinning stations (e.g., 70 and 75 mm). In addition, the device according to the invention allows collision-free interoperability of the service mechanisms, while achieving the shortest time before the spinning process is resumed.

**[0034]** The service robot 1 of a spinning station of a ring spinning machine producing yarn comprises a vertical frame provided with at least two vertical linear guides 2, 18, on which are mounted reversibly slidably groups 3, 4, 5 and 6 of handling means for carrying out service operations at the spinning station. At least one of the vertical linear guides 2, 18 is provided with an endless toothed belt 9, 17, which is at one end of the vertical linear guide 2, 18, in the shown exemplary embodiment at the upper end, wrapped around a drive pulley 7, 15 coupled to a rotary drive means and at the other end of the guide 2, 18, in the shown embodiment at the lower end, is wrapped around a freely rotatable tensioning pulley 8, 16. The toothed belt 9, 17 thus arranged constitutes a vertical belt drive of the handling means 3, 4, 5 and 6.

**[0035]** A first group 4 of handling means is mounted reversibly slidably in the vertical direction on the first vertical linear guide 2 and is provided with a drive pulley 10 coupled to a rotary drive, whereby a freely rotatable guide pulley 11 is arranged in the direction of one arm of the endless toothed belt 9 both above and below the drive pulley. An adjacent branch of the endless toothed belt 9 wraps alternately the upper guide pulley 11, the drive pulley 10 and the lower guide pulley 11. As a result, the

first group 4 of handling means is reversibly displaceable in the vertical direction not only by the drive pulley 7 relative to the first vertical guide 2, but also by the drive pulley 10 relative to the toothed belt 9. A second group 3 of handling means is mounted reversibly slidably in the vertical direction on the first vertical linear guide 2 and is provided with a carrier 33, which is permanently attached to the toothed belt 9. As a result, the second group 3 of handling means is vertically reversibly movable solely together with the toothed belt 9 and its vertical position is dependent on the motion of the drive pulley 7.

**[0036]** In the illustrated exemplary embodiment, a third group 6 of handling means is mounted in a loosely sliding manner, reversibly displaceably, i.e. in vertical direction, on the second vertical linear guide 18. The third group 6 of handling means is provided with a backstop 66, which after moving away the stop 230 on the movable member of the drive 23, for example, on the piston rod of the pneumatic cylinder, abuts the top of the ring bench 12 and is further lifted and lowered on the second vertical linear guide 18 solely by the effects of the ring bench 12 and in full synchronism with the motion of the ring bench 12. Or, in another arrangement not shown, the third group 6 of handling means is provided with a drive pulley coupled to a rotary drive, whereby a freely rotatable guide pulley is arranged in the direction of one arm of the endless toothed belt 17 both above and below the drive pulley. An adjacent branch of the endless toothed belt 17 wraps alternately the upper guide pulley, the drive pulley and the lower guide pulley, similarly to the group 4 of handling means in the drawing. Consequently, the third group 6 of handling means is reversibly displaceable in the vertical direction relative to the ring bench 12, as well as relative to the endless toothed belt 17, and it can be laid on the ring bench 12 by the backstop 66, thereby disconnect the drive and the group 6 is then moved by the effects of the ring bench 12 and synchronized with the motion of the ring bench 12. In the illustrated exemplary embodiment, for the purpose of driving the third group 6 of handling means or any of the groups 3, 4, 5, 6 of handling means due to the fact that the ring bench 12 acts directly on the respective group 3, 4, 5, 6 of handling means, this group 3, 4, 5, 6 of handling means has weight and mechanical resistance of its guidance on the vertical linear guide 2, 18, 20, 21 lower than is the vertical loadability of the ring bench 12 without affecting the drive and/or the motion of the ring bench 12. In an unillustrated embodiment, the group 3, 4, 5, 6 of handling means moving in synchronism with the ring bench 12 is provided with its own drive coupled to a sensor of its approaching the ring bench 12 and to the control device for the control of the motion of this group 3, 4, 5, 6 of handling means wich is synchronous with the motion of the ring bench 12.

**[0037]** A fourth group 5 of handling means is mounted reversibly slidably in the vertical direction on the second vertical linear guide 18 and is provided with a carrier 55, which is permanently attached to the toothed belt 17. The vertical motion of the fourth group 5 of handling means is dependent on the rotation of the drive pulley 15.

**[0038]** The vertical frame is in the illustrated exemplary embodiment further provided with outer vertical guides 20 and 21, which are associated either with unillustrated reversibly vertically displaceable groups of handling means coupled to linear drives 200, 210, or, as indicated in Fig. 3, on the frame is rigidly mounted at least one auxiliary group 22 of handling means, which is independent of the other groups 3, 4, 5, 6 of handling means and of the vertical linear guides 2, 18, 20, 21, whereby it is equipped with means for carrying out at least one service operation at the spinning station.

**[0039]** To improve the control of the individual elements of the service robot 1, at least one of the groups 3, 4, 5, 6 of handling means, displaceably mounted on the vertical linear guides 2, 18, 20, 21, is equipped with at least one sensor of its position on the vertical linear guide 2, 18, 20, 21, which is connected to the control device.

**[0040]** The drives of the movable groups 3, 4, 5, 6 of handling means for the motion on the vertical linear guides 2, 18, 20, 21 consist of stepper motors and/or linear motors, which are highly controllable means with a favourable ratio of performance to weight. To achieve further improvement in the controllability of the service robot 1, the means are provided with means for controlling their speed and/or position and/or direction of motion and are coupled to the control device.

**[0041]** The individual handling means of each group 3, 4, 5, 6 of handling means are coupled to mechanical and/or pneumatic and/or electronic drive elements, which enable to achieve desired peformance even with small dimensions and low weight.

**[0042]** The device according to the invention works in such a manner that the first group 3 of handling means is on the vertical linear guide 2 directly carried by the toothed belt 9, namely via the carrier 33, the toothed belt 9 being directly driven by the rotary drive through the rotary drive pulley 7. Also the second group 4 of handling means moves reversibly on the vertical linear guide 2 in the vertical direction, being carried only by the motion of the toothed belt 9, while the drive pulley 10 of the rotary drive means is not rotating, or the second group 4 of the handling means is carried only by the rotation of the drive pulley 10 of the rotary drive means, while the toothed belt 9 is not moving, or the second group 4 of handling means is carried due to a combined effect of the motion of the toothed belt 9 and concurrent rotatable motion of the drive pulley 10 of the rotary drive means. By these mutual combinations of the drive of the vertical reversible motion of the individual groups 3, 4 of handling means it is possible to achieve that the groups 3, 4 of handling means move concurrently or independently of each other, in the same direction or in the opposite directions, and then either at the same speed or at mutually different speeds, as indicated in Fig. 1 by arrows A, B. It follows that, for example, if the drive pulley 10 of the second group is stationary, this pulley 10 acts together with the guide pulleys 11 as

a temporarily activated static carrier of the second group 4 of handling means 4, which during the motion of the belt 9 moves along the vertical guide 2 together with the first group 3 of service means, i.e., at the same speed and at a constant distance from the first group 3. However, if, for example, the mutual distance between the first group 3 and the second group 4 of handling means is to be varied or the groups 3 and 4 of handling means are to be moved at different speeds, then the rotation of the drive pulley 10 of the second group 4 of handling means is activated, which ensures the necessary relative motion (both the speed and the direction) of the second group 4 of handling means with respect to the belt 9, which manifests itself as the relative motion of the first and the second groups 3 and 4 of handling means, or relative motion also with respect to the frame. The arrangement of Fig. 2 is such that the fourth group 5 of handling means moves reversibly in the vertical direction on the vertical linear guide 18 and is carried by the carrier 55 by the motion of the toothed belt 17 driven by the drive pulley 15. In synchronism with the ring bench 12, on the same vertical linear guide 18 moves the third group of handling means 6 comprising a backstop 66, which abuts the top of the ring bench 12 at the time of performing the service operation at the spinning station. When the service robot 1 is moving between the spinning stations of the machine, the backstop 66 and the third group of the handling means 6 are displaced by the action of the stop 19 on the movable member 20 of the drive 21 to the rest position, out of the reach of the moving ring bench 12.

**[0043]** Alternatively, in another unillustrated arrangement, the third group 6 of handling means is displaced by the action of the drive pulley coupled to the rotary drive on the vertical linear guide 18 and the endless toothed belt 17 from its rest position situated out of the reach of the motion of the ring bench 12, until the backstop 66 abuts the top of the ring bench 12. Subsequently, the drive is disconnected and the third group 6 is displaced solely by the ring bench 12. During the displacement of the groups of handling means 6 by the action of the ring bench 12, the drive pulley coupled to the rotary drive is rolling freely on the endless toothed belt 17.

**[0044]** The above-described arrangement of the groups 3, 4, 5, 6 of handling means on the vertical linear guides 2, 18 and the arrangement of other unillustrated groups of handling means on the vertical lateral linear guides 20, 21 allows independent or joint or mutually coordinated motion of the groups 3, 4, 5, 6 and other unillustrated groups of handling means.

**[0045]** As mentioned above, the ring spinning machine comprises a ring bench 12, whereby the service robot 1 is arranged as a vertical frame, which is provided with at least two vertical linear guides 2, 18, 20, 21, whereby at least one of it is associated with at least two movable groups 3, 4, 5, 6 of handling means to perform service operations at the spinning station. At least one of the groups 3, 4, 5, 6 of handling means is provided with means for reversible vertical motion together which is synchronous with the motion of the ring bench 12 of the ring spinning machine. In addition, these means for synchronous reversible vertical motion of the group 3, 4, 5, 6 of handling means together with the ring bench 12 comprise a backstop 66 to be laid on the ring bench 12. So as to make sure that a respective group 3, 4, 5, 6 of handling means with the means for synchronous reversible vertical motion together with the motion of the ring bench 12 does not affect the drive and/or the motions of the ring bench 12, the weight of this group 3, 4, 5, 6 of handling means with the backstop 66 and the mechanical resistance of its guiding on the vertical linear guide 2, 18, 20, 21 is lower than is the vertical loadability of the ring bench 12, and therefore it is not necessary for the application of the invention on the machine to strengthen the drives and the construction of the ring bench 12. Alternatively, the service robot 1 according to the present invention can be used on the ring spinning machines that have already been in operation.

**[0046]** In an unillustrated embodiment, the ring spinning machine is provided with at least one parking position for the service robot, wherein the parking position is arranged along the length of the machine outside the spinning stations, e.g. it is arranged at the beginning of the machine and/or at the end of the machine and/or near a drive unit of the machine located between the spinning stations. The service robot is then able to stop at this parking position, by which means the service robot assumes its parking position in which it does not interfere with the operation of the spinning stations or the other parts of the machine, nor does it interfere with the activities of the machine operator or other parts of the machine.

**Reference numbers**

**[0047]**

| | |
|---|---|
| 1 | Service robot |
| 2 | Vertical linear guide |
| 3 | Group |
| 4 | Group |
| 5 | Group |
| 6 | Group |
| 7 | Drive pulley |
| 8 | Rotatable pulley |
| 9 | Toothed belt |
| 10 | Drive pulley |
| 11 | Guide pulley |
| 12 | Ring bench |
| 13 | Spindle |
| 14 | Guide |
| 15 | Drive pulley |
| 16 | Rotatable pulley |
| 17 | Toothed belt |
| 18 | Vertical linear guide |
| 20 | Vertical linear guide |
| 200 | Linear Drive |

21 Vertical linear guide
210 Linear Drive
22 Auxiliary group
23 Drive
230 Stop
33 Carrier
55 Carrier
66 Backstop

A Arrow
B Arrow
C Direction
D Direction

**Claims**

**1.** A service robot (1) of a ring spinning machine, said service robot (1) arranged displaceably along a row of spinning stations can be stopped at a selected spinning station which requires a service operation, whereby the service robot (1) is provided with groups (3, 4, 5, 6) of handling means coupled to drives, **characterized in that** the service robot (1) is arranged as a vertical frame, which is provided with at least two vertical linear guides (2, 18, 20, 21), at least one of which is associated with at least two movable groups (3, 4, 5, 6) of handling means to perform service operations at the spinning station.

**2.** The service robot (1) according to claim 1, **characterized in that** the vertical linear guides (2, 18) are provided with an endless belt (9, 17), which is wrapped at one end of the guide (2, 18) around a drive pulley (7, 15) and at the other end of the guide (2, 18) is wrapped around a freely rotatable pulley (8, 16), whereby attached to the belt (9, 17) is a carrier (33, 55) of one group (3, 5) of handling means and, in addition, at least one other group (4, 6) of handling means is movably and disconnectably coupled to the belt (9, 17).

**3.** The service robot (1) according to claim 2, **characterized in that** this at least one other group (4, 6) of handling means is coupled to the belt (9, 17) movably and disconnectably by a drive pulley (10), which is coupled to a rotary drive, whereby a pair of freely rotatable guide pulleys (11) is assigned to the drive pulley (10), whereby the guide pulleys (11) are arranged relative to the drive pulley (10) to ensure the wrapping of the drive pulley (10) by the belt (9, 17).

**4.** The service robot according to any of claims 1 to 3, **characterized in that** at least one of the groups (3, 4, 5, 6) of handling means is provided with means for synchronous vertical reciprocating motion along with the motion of a ring bench (12) of the ring spinning machine.

**5.** The service robot according to claim 4, **characterized in that** at least one of the groups (3, 4, 5, 6) of handling means comprises a backstop (66) for laying the group (3, 4, 5, 6) of handling means on the ring bench (12).

**6.** The service robot according to claim 5, **characterized in that** the group (3, 4, 5, 6) of handling means with means for synchronous vertical reciprocating motion together with the motion of the ring bench (12) has weight and mechanical resistance of its guidance on the vertical linear guide (2, 18, 20, 21) lower than is the vertical loadability of the ring bench (12) without affecting the drive and/or the motion of the ring bench (12).

**7.** The service robot according to any of claims 1 to 6, **characterized in that** on the frame is fixed at least one auxiliary group (22) of handling means, which is independent of the other groups (3, 4, 5, 6) of handling means.

**8.** The service robot according to any of claims 1 to 7, **characterized in that** at least one of the groups (3, 4, 5, 6) of handling means displaceably mounted on the vertical linear guides (2, 18, 20, 21) is provided with at least one position sensor.

**9.** The service robot according to any of claims 1 to 8, **characterized in that** the movable groups (3, 4, 5, 6) of handling means are for motion on the vertical linear guides (2, 18, 20, 21) coupled to drives formed by stepper motors and/or linear motors.

**10.** The service robot according to claim 9, **characterized in that** the drives of the movable groups (3, 4, 5, 6) of handling means for motion on the vertical linear guides (2, 18, 20, 21) are provided with means of controlling their speed and/or position and/or direction of motion and are coupled to the control device.

**11.** The service robot according to any of claims 1 to 9, **characterized in that** the handling means of the groups (3, 4, 5, 6) of the handling means are coupled to mechanical and/or pneumatic and/or electronic driving elements.

**12.** A ring spinning machine with a service robot according to any of the claims 1 to 11, wherein the service robot arranged displaceably along a row of spinning stations can be stopped at a selected spinning station which requires a service operation, **characterized in that** the service robot (1) is arranged as a vertical frame, which is provided with at least two vertical linear guides (2, 18, 20, 21), at least one of which is associated with at least two movable groups (3, 4, 5, 6) of handling means to perform service op-

erations at the spinning station.

**13.** The ring spinning machine according to claim 12 comprising a ring bench (12), **characterized in that**

- at least one of the groups (3, 4, 5, 6) of handling means is provided with means for synchronous vertical reciprocating motion along with the motion of a ring bench (12) of the ring spinning machine;
- the means for the synchronous vertical reciprocating motion of the group (3, 4, 5, 6) of handling means together with the ring bench (12) comprise a backstop (66) to be laid on the ring bench (12); and
- the group (3, 4, 5, 6) of handling means with means for synchronous vertical reciprocating motion together with the motion of the ring bench (12) has weight and mechanical resistance of its guidance on the vertical linear guide (2, 18, 20, 21) lower than is the vertical loadability of the ring bench (12) without affecting the drive and/or the motion of the ring bench (12).

**14.** The ring spinning machine according to claim 12 or 13, **characterized in that it** contains at least one parking position for the service robot, the robot is stoppable on the parking position of the robot and the parking position is situated outside the spinning stations at the beginning of the machine and/or at the end of the machine and/or at the drive unit of the machine situated between spinning stations.

**15.** A method of controlling groups (3, 4, 5, 6) of handling means of the service robot of a ring spinning machine according to any of claims 1 to 11, in which the motion of the groups (3, 4, 5, 6) of handling means is controlled in the vertical direction,
**characterized in that**

- at least two groups (3, 4, 5, 6) of handling means move simultaneously along a common vertical guide and maintain the same distance between them; or
- one of at least two groups (3, 4, 5, 6) of handling means is moving along the common vertical guide, and the other group (3, 4, 5, 6) of handling means stops; or
- at least two groups (3, 4, 5, 6) of handling means move along the common vertical guide with varying their mutual distance; or
- at least two groups (3, 4, 5, 6) of handling means move along the common vertical guide, wherein one of them moves by the action of the ring bench (12) synchronously together with the movable ring bench (12).

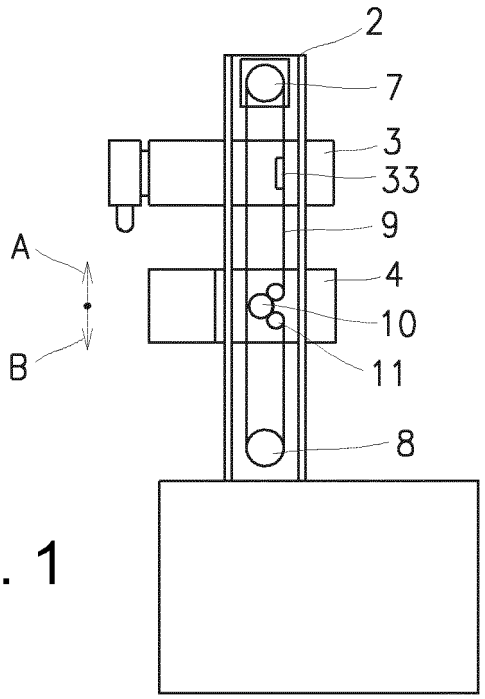


Fig. 1

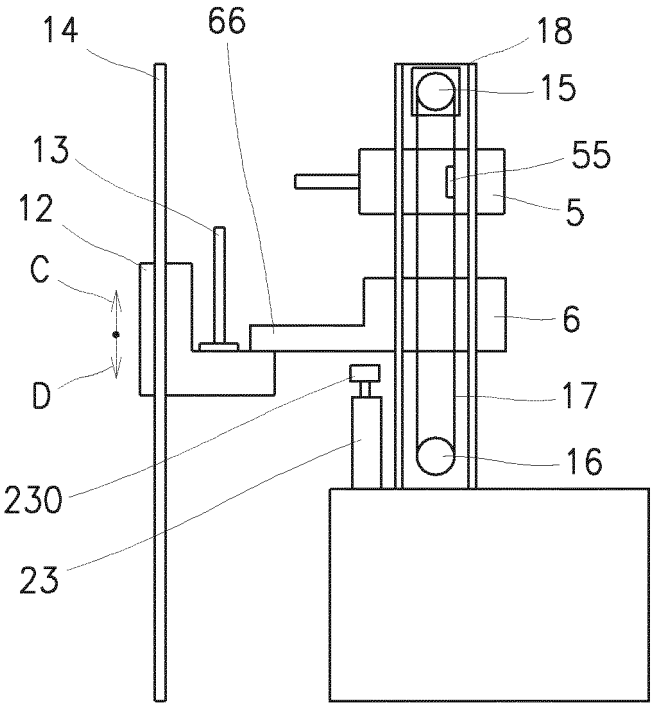


Fig. 2

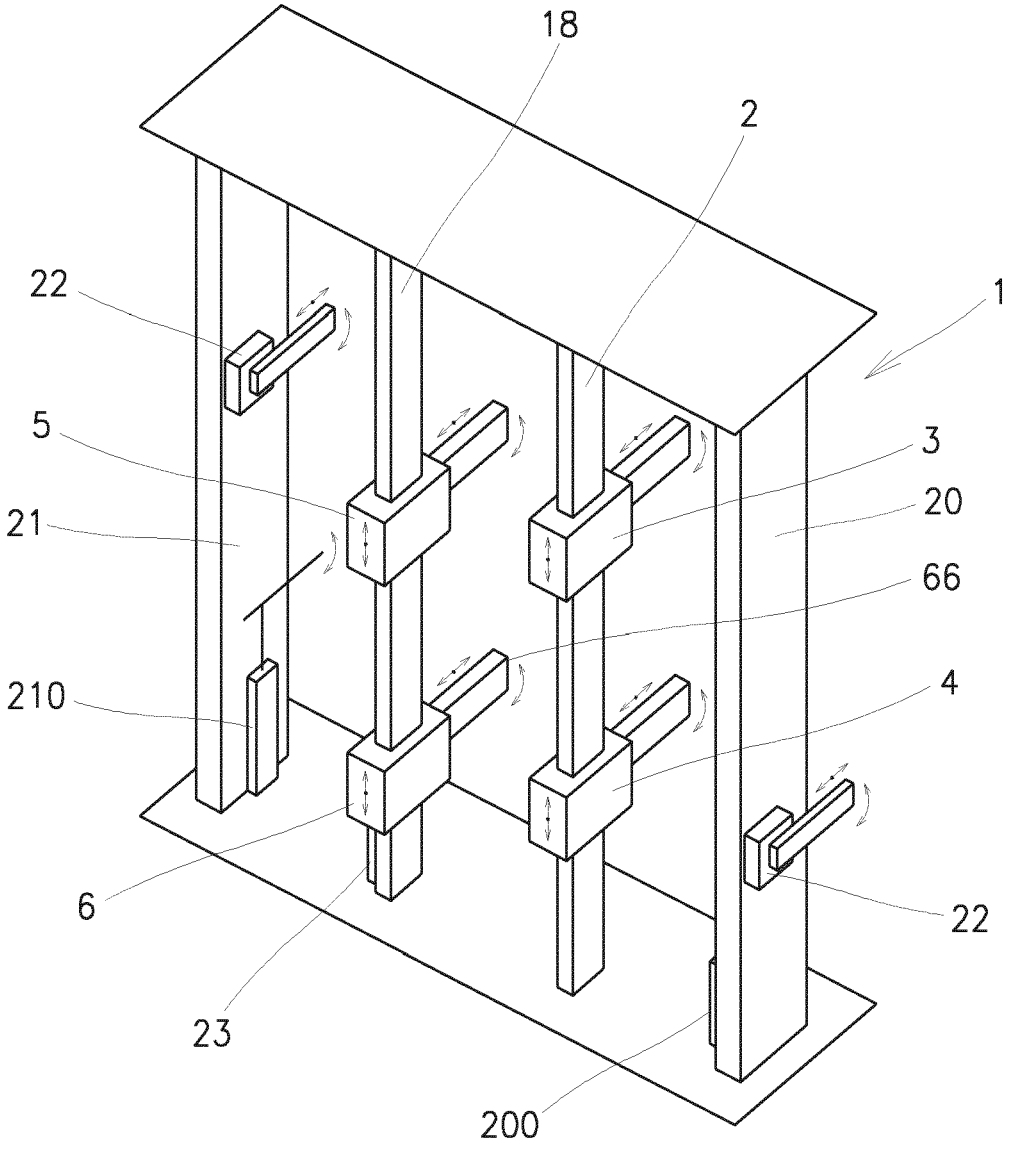


Fig. 3

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# EUROPEAN SEARCH REPORT

Application Number
EP 19 15 2442

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D01H
B65H

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
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| Munich | 23 May 2019 | Hausding, Jan |

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