

(19)



(11)

EP 2 083 102 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

29.07.2009 Bulletin 2009/31

(51) Int Cl.:

D01H 9/04 (2006.01)(21) Application number: **08171085.7**(22) Date of filing: **09.12.2008**

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**

Designated Extension States:

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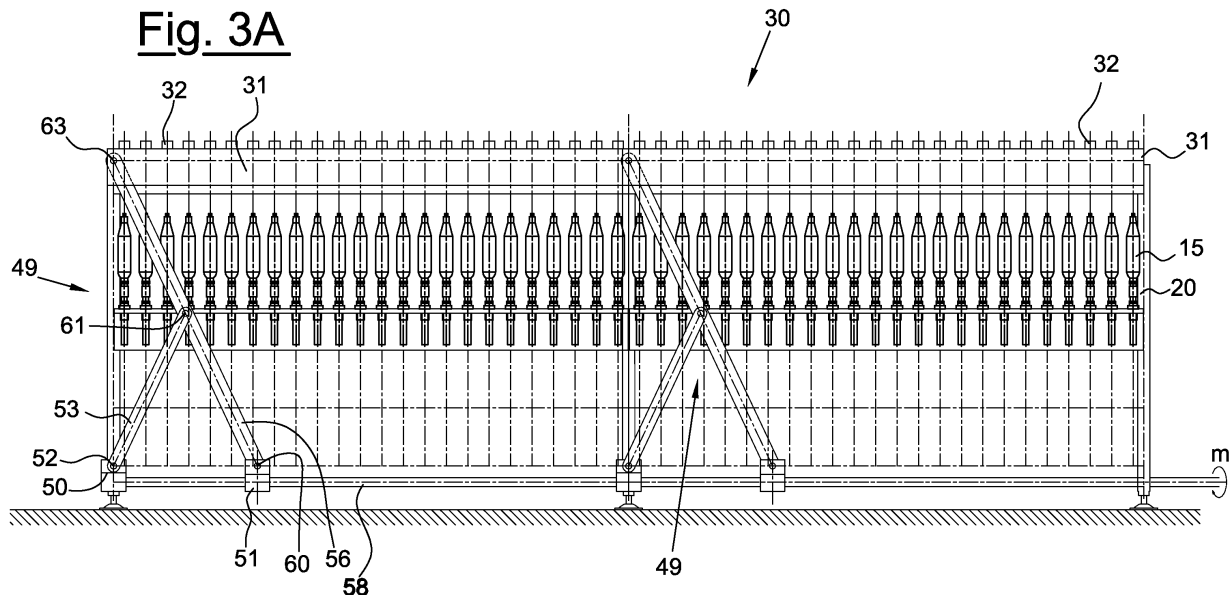
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20121 Milano (IT)**(54) **Device and process for the doffing of the bobbins from the ring spinning frames**

(57) Doffing device (30) for ring spinning frames in which tubes (16) and bobbins (15) are moved between the bobbin carrier spindles (20) and an individual transport device (27) of empty tubes or finished bobbins to be transported, comprising a clamp carrier bar (31) in which

such empty tubes and finished bobbins are engaged with clamps (32) brought closer to or further away from the face of the machine, with a series of movable arms (34) placed on the clamp carrier bar (31), in turn borne by a support pantograph (49) only driven downward or upward, without rotary movements.

Fig. 3A**EP 2 083 102 A2**

Description

[0001] The present invention refers to a device and process for doffing in the ring spinning frames.

[0002] In industrial practice, the yarn production technique is widely prevalent that includes a first stage of ring spinning which produces bobbin yarn, followed by a second winding stage in which the yarn is unwound from its bobbin, cleaned of its defects and rewound in a package, which contains a much greater yarn quantity and which corresponds to a considerable number of processed bobbins. The winding processing is much faster than the spinning, and thus a small quantity of winding stations or units, on the order of several dozen, is capable of completing the production of a great number of ring spinning units, on the order of several thousand.

[0003] In general, the ring spinning frame is composed of hundreds of spinning units, arranged on each of the two machine faces, with a driving, governing and control unit of the machine placed at one of its ends and with a transport system which serves the two faces of the machine. The trend towards machines with increasing productivity involves the increase of the number of units and increasingly longer machines.

[0004] On the spinning frame, the transfer of the bobbins replete with yarn to be sent to the winder, and the transfer of the empty tubes (on which new bobbins are wound) to the spinning units generally occurs by individually moving bobbins and tubes in erect position, for example on pins inserted on longitudinal metal strips which slide on the faces of the spinning frame or on peg support pins borne by conveyor belts or strips.

[0005] Still generally, in yarn production, a spinning frame is coupled to a winder having hourly winding capacity that considerably exceeds the spinning capacity of the spinning frame, so to complete, with a certain margin, the entire spinning production.

[0006] The spinning process on the ring spinning frame is governed by a governing and control unit which detects the achievement of the produced meters of yarn in bobbins on every unit of the spinning frame, stops the spinning according to a procedure which leaves the yarns in predetermined position and proceeds with the doffing. In brief, the doffing consists of drawing the finished bobbins from the respective spinning units and unloading them on the transport system of the spinning frame, and of the subsequent drawing of the empty tubes from the transport system and positioning them on the ring spinning units, operating in parallel over all the spinning units which compose the ring spinning frame. For such purpose, the ring spinning frame is provided with a doffing device which is capable of lifting itself and simultaneously grasping all the completed bobbins over all the spinning units which compose the spinning frame, with a series of individual clamps which are brought to take the bobbins, to lift themselves, taking the bobbins from the bobbin carrier spindles on which the bobbins are fit, and then lowering themselves in order to deposit the bobbins on

the individual supports which form the transport system. The same device then provides for taking the empty tubes and fitting them on the bobbin carrier spindles freed of the bobbins in the previous operation.

[0007] Such operation has considerable problems deriving from the fact that the same doffing device must simultaneously serve the hundreds of spinning units - currently as many as 500 on each face - placed over a length of dozens of meters. Bobbins and tubes must be taken and positioned with respect to the transport pins and to the bobbin carrier spindles with a precision on the order of millimetres, moving them while taking into account the bulk and obstacles and exerting forces on the order of a ton in order to lift the doffing device, the entire face of the completed bobbins and tearing their yarns bound to the respective spinning units.

[0008] In the prior art, the doffing device uses a clamp carrier bar borne by an extendible pantograph, capable of positioning, taking and lifting bobbins and tubes from the bobbin carrier spindles, from the parking stations and from the pins of the underlying transport system. Such pantograph is made height-extendible between the two above-mentioned levels, and is also rotatable 15-25° in accordance with an axis parallel to the face of the machine, in order to avoid the bulk of the spindle carrier rail and the other members of the spinning units arranged along the face. Parking stations are provided of the waiting empty tubes; such station can be brought to an intermediate level and aligned with the spinning spindle or up to the level of the moving belts, though offset by a half pitch with respect to the spinning spindle of the unloaded bobbin: in both cases, the movement is complicated by the precision needs of the relative position of the clamps with respect to the bobbins and the tubes to be moved.

[0009] The present invention is aimed for the doffing of the finished bobbin and its substitution with an empty tube which simplifies such yarn processing step and makes it more efficient.

[0010] The invention is described here with reference to a typical embodiment thereof in a ring spinning station.

[0011] The present invention, in its most general meaning as device for bobbin doffing and substitution, is defined in the first claim. Its variants or preferred embodiments are defined in the dependent claims 2 - 8.

[0012] The present invention, in its meaning as a process for bobbin doffing and substitution, is defined in claim 9. Its preferred variants or embodiments are defined in the dependent claims 10 - 12.

[0013] The characteristics and advantages of the bobbin doffing device and process according to the present invention is more evident from the exemplifying but non-limiting description of a typical embodiment thereof, illustrated in the following figures. Figure 1 schematically shows, in section, a ring spinning group of conventional type, while figure 2 schematically shows, in section, two spinning units on the two faces of the spinning frame with their members involved in the doffing operation. Figures 3A and 3B show the doffing device in front view, respec-

tively in its maximum and minimum elevation positions, figure 4 shows, in front view, the positions between which the bobbins and tubes are moved, and figure 5 shows the detail of the extension driving of the clamps engaging bobbins and tubes.

[0014] For an improved comprehension of the problems and technical solutions connected with the ring spinning, the conventional scheme is described overall of a spinning unit with reference to the figures 1 and 2, considering that every spinning frame is composed of a plurality of spinning stations aligned along its two faces. Every spinning frame face is composed of hundreds of such stations, which commonly derive their driving from motors which actuate longitudinal axes, and their functions from dispenser units which distribute them along the machine. The spinning frame is generally structured with a sequence of modules of transportable size, composed of a plurality of spinning stations; such modules are then brought to and assembled on site, so to offer the complete spinning frame. The modules shown in the figures are typically formed of twenty-four spinning units for each face.

[0015] The sliver 1 fed to the spinning units comes from a series of packages 2 hung above the spinning units, and is brought forward to the drafting unit 3. This generally consists of a plurality of driving members of the sliver at increasing linear speeds; such driving members gradually refine such sliver by making the fibres composing it slide between them. The drafting group is depicted in figures 1 and 2, for example, with three pairs of drafting rollers or cylinders, of which the lower cylinder is made with a grooved segment of a longitudinal bar, shared with the adjacent spinning stations and rotating in accordance with the arrow a). The upper cylinder is idle, made with elastomeric material and is driven into movement in accordance with the arrow b) by the lower cylinder, on which it is pressed by a support. The final pair of drafting rollers imparts the final drafting on the sliver, such rollers being driven at a greater linear speed than that of the preceding roller pairs. At the end of the drafting group, the sliver has already assumed the size of the yarn 10 and already receives the twisting from the underlying ring spinning unit.

[0016] The yarn 10 first passes into the thread guides 11, typically of pig's tail form, and from here to a rotating slider which rotates on a fixed ring 12, with diameter slightly greater than the bobbin to be produced and borne by a ring-rail 14 shared with the adjacent spinning units. The ring-rail 14 is continuously moved in accordance with the arrow c) in two directions, to continuously lift and lower all the fixed rings 12 of the single spinning units around their bobbins being formed and to distribute the yarn 10 on the tube 16 of every bobbin 15 being wound. The tube 16 is fit on the underlying rotating spindle 20 driven into rotation at high speeds, which currently are in the range of 10,000-20,000 rpm. In general, such driving is carried out with drive belts 22, which slidably engage the lower part 21 of the bobbin carrier spindle 20.

[0017] With every rotation of the spindle 20, i.e. of the bobbin 15, the yarn released by the drafting group 3 is drawn so to be wound on the bobbin 15. Substantially, a twisting turn of the yarn 10 is generated, which drives in rotation the rotating slider, although with a slight delay due to its friction with the guide ring 12. If the spindle rotates at N revolutions per minute and the final cylinders of the drafting group 3 release L meters per minute of drafted sliver 10, except for shortening due to twisting, the twists T applied to a meter of produced yarn result equal to N/L.

[0018] The yarn 10 rotates in a whirling manner around the bobbin, forming the so-called "balloon" due to the centrifugal force. The balloon is due to significant stress on the yarn 10 and can be limited with a containment ring 18, in general of slightly greater diameter than the transverse size of the bobbin 15.

[0019] The thread guide 11 is also mounted on a movable platform or rail 13, like the balloon containment ring 18 which is firmly mounted on a platform or rail 19 thereof, capable of vertical travel movements which keep them spaced from each other and in any case above the level of the ring-rail 14. For such purpose, the three rails 14, 13 and 19 are guided with vertical guides 25 on the two faces of the spinning frame and lifted and lowered with a belt and pulley system 26 which periodically raises and lowers the three rails, in accordance with predetermined rates.

[0020] The yarn twisting is caused by the rotation of the bobbin 15 and extends, together with the relative stresses, up to the point at which the sliver of the yarn 10 is released by the final cylinders of the draft group 3. In order to wind the yarn thus twisted on the bobbin 15 in a regular manner, as the bobbin progressively forms, it is necessary to distribute it on the bobbin at different heights, continuously changing the level of the rotating slider borne by the ring-rail 14, continuously moved in accordance with the arrow c) in two directions, and modulating the deposit so as to continuously raise the mid-point of the travel of the arrow c). The deposit of the yarn 10 on the bobbin 15 generally starts in the lower part of the bobbin and rises upward in overlapped layers with conical progression, layers obtained with a series of slow, ascending movements of the ring-rail 14 following by sudden and slightly shorter descending movements. The object of such bobbin winding method is essentially that of giving a tapered shape to the bobbin, so that the bobbin results compact, so that it does not break up during its unwinding, and so that the yarn is unwound, substantially unwinding layer-by-layer from its upper conical part.

[0021] According to the present invention, the doffing device 30 shown in figures 2 and 3 is achieved with the following modes. The device 30 is provided for moving tubes and bobbins between the bobbin carrier spindle 20 of each of the spinning units and a transport device, shown as an example with a service conveyor belt 27 on the two faces of the spinning frame, on which the pegs 28 circulate, composed of a disc base and provided with

an upper vertical pin on which the empty tube or the finished bobbin to be transported are fit from time to time, respectively from the winder to the spinning frame or vice versa. The transport device 27 can also be made as a metal strip which bears vertical pins fixed thereon.

[0022] Close to and parallel to the conveyor belt 27, for each face of the spinning frame, a parking station is provided composed of a series of vertical pins 29, one for each ring spinning unit, which are integral with the fixed structure of the machine. As said, said positions between which bobbins and tubes are moved are shown in front view in figure 4.

[0023] The doffing device 30 constitutes a particular feature of the invention and comprises:

- a clamp carrier bar 31 as long as the face of the spinning frame, on which the clamps 32 are borne and mounted for the engagement of the bobbins 15 and the tubes 16 to be moved. In general, the actual clamp 32 is composed of a rigid cylindrical ring body having at its interior an annular chamber inflatable with the injection of compressed air. The transverse size of the inflatable annular chamber is determined in such a manner that, with non-inflated chamber, it can be easily inserted and removed from the bobbin 15 or tube 16. The re-inflating with compressed air of the chamber instead locks the tube and allows raising the tube 16 or bobbin 15 and moving them by exerting the necessary forces, while the release of the compressed air allows freeing it after the movement. According to a preferable embodiment of the invention, the clamp 32 is provided for engaging the upper part of the tube 16;
- a series of connection and support arms 34 of the clamps 32 on the clamp carrier bar 31. As illustrated with figure 2 and with figure 5 - which report a planimetric view of the work positions of the clamps 32
- the arms 34 are composed of bars pivoted on pins 35 on the clamp carrier bar 31 and can rotate between the various angles of the work positions, in accordance with the arrows r , approaching or moving away from the face of the machine.

In figures 2 and 5, on the left, the clamps are shown brought to the maximum height and to the maximum extension for working on the bobbin carrier spindles 20, for taking the finished bobbin 15 or for placing the empty tube 16; on the right, the clamps are shown that have been brought to the minimum height and to the minimum extension for working on the bobbin carrier spindles 20 so to take or place the finished bobbin 15 on one of the vertical parking pins 29. For example, the references A and B indicate the longitudinal coordinate of two adjacent spinning units A and B on one of the faces of the machine. The plate 28A bears the bobbin or the tube for the spinning unit A, the pin 29A serves as parking for the spinning unit A: the spinning, drawing or deposit positions on the peg 28 on the conveyor belt 27 and parking on

the pin 29 result longitudinally offset in accordance with the rotation r of the arm 34 around its pin 35. The driving in rotation r of the arms 34 can be made with mechanical, hydraulic or pneumatic command. In figure 5, a mechanical driving system is shown as an example. It comprises a connection bar 40 of all the arms 34 which bear the clamps 32 by means of pins 41: this connection constrains all the arms to coherently rotate in accordance with the axial translation of the bar 40. At the end of the connection bar 40, a plate 42 is in fact mounted of circular sector form, which is connected with a pin 43 to the bar 40. The plate 42 is in turn pivoted on the clamp carrier bar 31 with a pin 44, so to make a pantograph for the approaching/moving away movement of the clamps 32 with respect to the movement positions in the horizontal plane. For such purpose, the pins 35 and 41 of the arms 34 and the pins 43 and 44 of the plate 42 are mounted at the same distance d from each other. The driving in rotation around the pin 44 of the plate 42 is achieved, as an example, by making a toothing 46 on the edge of the circular sector which constitutes the plate 42, which engages a coherent toothing of a gearmotor 47, with high reduction ratio; such gearmotor is made to rotate in clockwise/anticlockwise sense for imparting the alternating rotations in accordance with the arrows r to the plate 42. Alternatively, the bar 40 can be driven in axial translation with a screw/nut screw system driven in rotation with a stepping motor in controlled rotation in the two directions.

Alternatively to the modes for bringing the clamps 32 and the relative arms 34 closer to/further away from the spinning units with rotations (r) described up to now, such movements can also be achieved by translation, maintaining such arms in fixed and orthogonal position with respect to the clamp carrier bar 31, providing them with a slider part which bears the clamp 32 and which is extendible in order to be orthogonally lengthened and retracted with respect to the spinning units which it must serve. For example, the extendible part can be made with a rack which is made to advance or retract in accordance with the rotation of a rotating bar, axially arranged on the bar 31 and provided with toothing which engages the entire toothing of the rack of the clamp carrier arms;

- a pantograph device 49 for lifting and lowering the clamp carrier bar 31. The pantograph is composed of a plurality of lifting arms arranged along the faces of the spinning frame in accordance with a kinematic type that is known in the art. Each of the arms comprises a pair of support bodies 50 and 51, with one fixed and other slidable along the longitudinal axis of the spinning frame. In particular, the fixed support 50 bears, on its upper part, a constraining pin 52 of the connection strut 53 with the lifting arm 56. The movable support 51 bears, at its interior, a nut screw

which engages a threaded bar 58 and which makes the support body 51 advance towards the right or left depending on the clockwise/anticlockwise rotation m imparted to the threaded bar 58. On its upper face, the movable support 51 supports a lower constraining pin 60 of the lifting arm 56. Such arm 56 bears, in its intermediate point, a constraining pin 61 with the strut 53 and at its upper ends a constraining pin 63 with the clamp carrier bar 31.

[0024] Depending on the rotation m imparted to the threaded bar 58, for each lifting arm 56 placed on the faces of the spinning frame, the movable support 51 moves closer to or away from the fixed support 50 to which it is bound with the strut 53 and, respectively, it lifts or lowers the lifting arm 56 and with this lifts or lowers vertically the clamp carrier bar 31 to the desired work levels. Salient feature and advantage of such pantograph 49 supporting the clamp carrier bar 31 is that it does not require back and forth rotary movements with respect to the face of the spinning frame for taking and placing the moved bobbins and tubes.

[0025] The doffing of the bobbins is carried out as follows, as an example. The ring spinning process is governed by a governing and control unit which detects the achievement of the desired yarn quantity in meters, produced in bobbins on every spinning unit, and it commands the start of the doffing process of the completed bobbins 15 and their substitution with new tubes 16, on which new bobbins will have to be wound, operating in parallel over all the spinning units which compose the ring spinning frame.

[0026] The spinning frame first provides for binding the yarns 10 on the lower ring nuts of the bobbin carrier spindles 20, stopping the rotation of the spindles, lowering the ring-rail 14 and the balloon containment ring 18 in all the spinning units as well as raising the thread guide 11 so as to not interfere with the doffing members.

[0027] The doffing sequence is exemplifyingly carried out with the following steps:

- ascending of the pantograph 49,
- rotation of the clamp carrier arms 34 in the position of the spindles 20,
- descending of the pantograph 49 so to fit the clamps 32 on the finished bobbins 15 and close them,
- lifting the pantograph 49 to the maximum level, tearing of the yarn tails and extraction of the bobbins 15 from the bobbin carrier spindles 20,
- rotation of the arms 34 in the retracted position of the pins 29,
- descending of the pantograph 49 so to fit the bobbins 15 on the parking pins 29,
- opening of the clamps 32 with release of the bobbins 15 on the pins 29,
- partial re-ascending of the pantograph 49 with simultaneous rotation of the arms 34 in the intermediate travel position of the conveyor belt 27,

- descending of the pantograph 49 until it inserts the clamps 32 on the tip of the tubes 16 on the pegs 28 on the conveyor belt 27 and to close the clamps 32,
- re-ascending of the pantograph 49 to the maximum level, bringing the tubes 16 therewith,
- rotation of the clamp carrier arms 34 in the extended position of the spindles 20,
- descending of the pantograph 49 so to fit the tubes 16 on the spindles 20, clamp opening and release of the tubes,
- re-ascending of the pantograph 49 to the maximum level and rotation of the arms 34 in the retracted position of the pins 29.

[0028] The process according to the invention provides for freeing the spindles 20 of the finished bobbins and to fit the new tubes thereon, before starting the transportation of the bobbins towards the winding. The completed bobbins are positioned on the parking station of the pins 29.

[0029] At this point, the spinning frame can start the so-called "spindleful", i.e. restart the production of new bobbins on the new changed tubes. The doffing continues as follows:

- descending of the pantograph 49 to the minimum level, closure of the clamps 32 on the tips of the bobbins 15 parked on the pins 29,
- partial re-ascending of the pantograph 49,
- rotation of the arms 34 in the intermediate travel position of the conveyor belt 27,
- descending of the pantograph 49 so to fit the finished bobbins 15 on the pins of the pegs 28 on the conveyor belt 27, opening of the clamps 32 and release of the bobbins,
- partial re-ascending of the pantograph 49 and rotation of the arms 34 in the retracted position of the pins 29.

[0030] At this point, with the spinning already underway, the finished bobbins 15 are progressively brought by the conveyor belt 27 to the subsequent winding.

[0031] With respect to the technical solutions of the prior art, currently in use, which first deposit the bobbins on the conveyor belt and then bring the tubes to the spinning units, the doffing results shorter and with less dead times in spinning. With regard to the doffing device, the execution of the approaching and moving away movement to/from the spinning units with only the clamps 32, rather than with the entire pantograph, leads to considerable improvements. The bulk of the device does not increase during the doffing. It is not necessary to have the conveyor belt make half pitches for bobbins and tubes during the doffing, with greater driving precision. The rotation mechanism for the approaching and moving away only affects the clamp carrier arms and not the entire pantograph: the movements result more precise. The space underneath the spindle carrier rail results free and

is thus available both for reducing the height of the spinning frame, and for working with tubes of increasing length, or finally for inserting other devices without increasing the height of the spinning frame. The travel path of the conveyor belts for tubes and bobbins is not affected by the bulk of the machine section, and can be placed at the sides of the control heads without modifying their shape.

Claims

1. Doffing device (30) for moving, in a ring spinning frame, tubes (16) and bobbins (15) between the bobbin carrier spindles (20) of the spinning units which compose the spinning frame and a service transport device (27) on the two faces of the spinning frame, on which the empty tube or the finished bobbin to be transported are brought from time to time, comprising a clamp carrier bar (31) which bears clamps (32) for the engagement of the bobbins (15) and the tubes (16) to be moved and a pantograph device (49) for lifting and lowering the clamp carrier bar (31), **characterised in that** the clamps (32) are borne with a series of arms (34) placed on the clamp carrier bar (31) and moved closer to or away from the face of the machine in the work positions, and that the support pantograph (49) of the clamp carrier bar (31) is only driven downward or upward, without requiring rotary movements in moving closer to and away from the face of the spinning frame.
2. Doffing device according to claim 1, **characterised in that** the arms (34) are placed and pivoted on the clamp carrier bar (31) so to rotate with rotation (r) in the various angles of the work positions.
3. Doffing device according to claim 1, **characterised in that** the clamp carrier arms are moved by translation, maintaining such arms in fixed position, orthogonal with respect to the clamp carrier bar (31) and providing them with a slider part which bears the clamp (32) and which is extendible in order to be orthogonally lengthened and retracted with respect to the spinning units.
4. Doffing device according to claim 1, **characterised in that** near and parallel to the service transport device (27) on the two faces of the spinning frame, a parking station is provided for which is constituted by a series of vertical pins (29), one for each ring spinning unit, integral with the fixed structure of the machine.
5. Doffing device according to claim 2, **characterised in that** the rotation (r) of the arms (34) is made with a bar (40) for connecting all the arms (34) with pins (41), which constrain all the arms to coherently rotate

with each other in accordance with the axial translation of the bar (40), so to form a pantograph for the approaching/moving away movement of the clamps (32) with respect to the movement positions in the horizontal plane.

6. Doffing device according to claim 5, **characterised in that** at the end of the connection bar (40), a plate (42) is mounted which is connected with a pin (43) to the bar (40) and in turn pivoted on the clamp carrier bar (31) with a pin (44) for driving the pantograph for moving the clamps (32) closer / further away.
7. Doffing device according to claim 6, **characterised in that** the driving in rotation around the pin (44) of the plate (42) is made by making a toothing (46) in the edge of the plate (42), which engages a coherent toothing of a gearmotor (47) which is made to rotate in clockwise/anticlockwise sense in order to impart alternating rotations in accordance with the arrows (r) to the plate (42).
8. Doffing device according to claim 5, **characterised in that** the connection bar (40) is driven into axial translation with a screw/nut screw system driven in rotation with a stepping motor in controlled rotation in the two directions.
9. Doffing process for moving, in a ring spinning frame, empty tubes (16) and finished bobbins (15) between the bobbin carrier spindles (20) of the spinning units which compose the spinning frame, a parking station constituted by pins (29) and a service transport device (27) on the two faces of the spinning frame, on which the empty tube or the finished bobbin to be transported are individual brought from time to time, by means of a doffing device (30) comprising a clamp carrier bar (31) which bears clamps (32) for engaging the bobbins (15) and the tubes (16) to be moved and a pantograph device (49) for the lifting and lowering of the clamp carrier bar (31), **characterised in that** first the bobbin carrier spindles (20) are freed of the finished bobbins (15), positioning them on the parking station of the pins (29), that then the new tubes (16) are drawn on the transport device (27) and then fit on the freed bobbin carrier spindles (20), once again starting the spinning, and that finally the finished bobbins (15) positioned on the parking station of the pins (29) are drawn and delivered to the transport device (27) for their transport to the winding.
10. Doffing process according to claim 9, **characterised in that** bobbins (15) and tubes (16) are moved with clamps (32) which engage the upper part of the tube (16).
11. Doffing process according to claim 9, **characterised in that** the support pantograph (49) of the clamp car-

rier bar (31) is only driven downward or upward, without rotary movements approaching or moving away from the face of the spinning frame.

- 12.** Doffing process according to claim 11, **characterised in that** the clamps (32) are borne in their work positions, approaching or moving away from the face of the machine, with series of movable arms (34) placed on the clamp carrier bar (31).

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Fig. 1

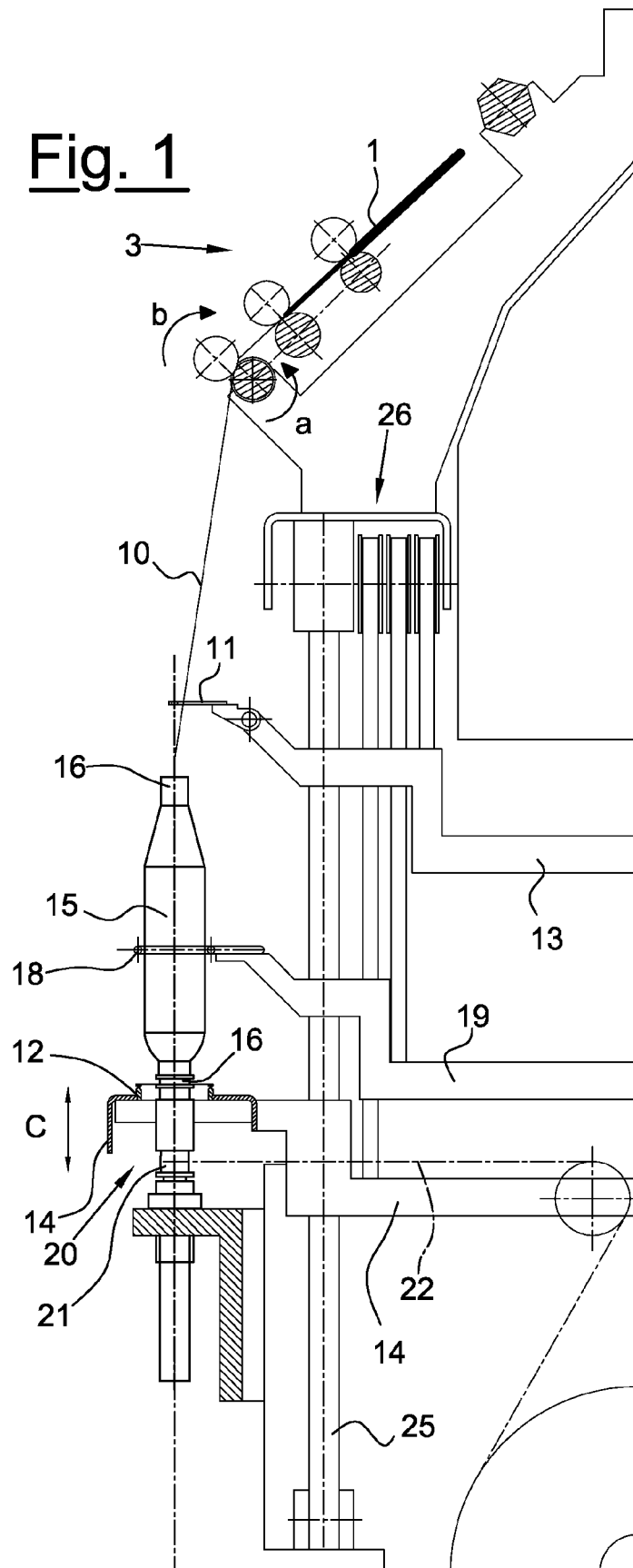
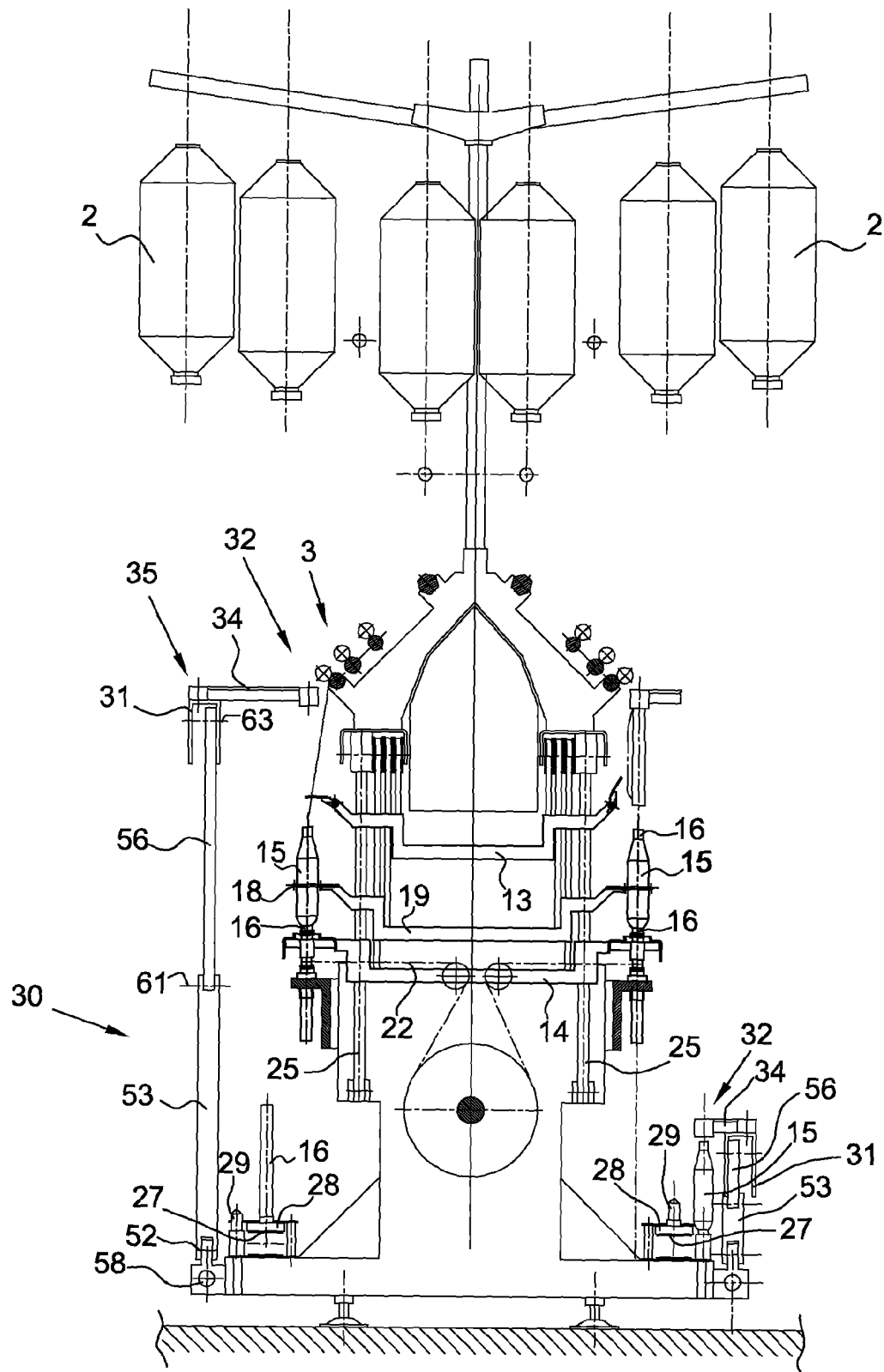


Fig. 2



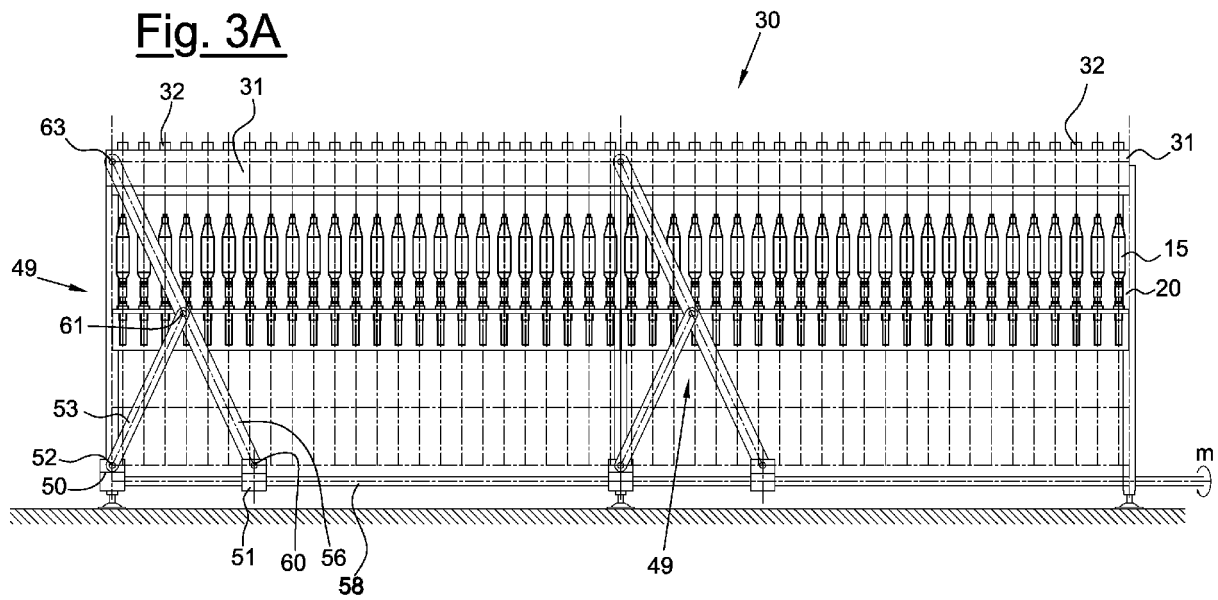


Fig. 3B

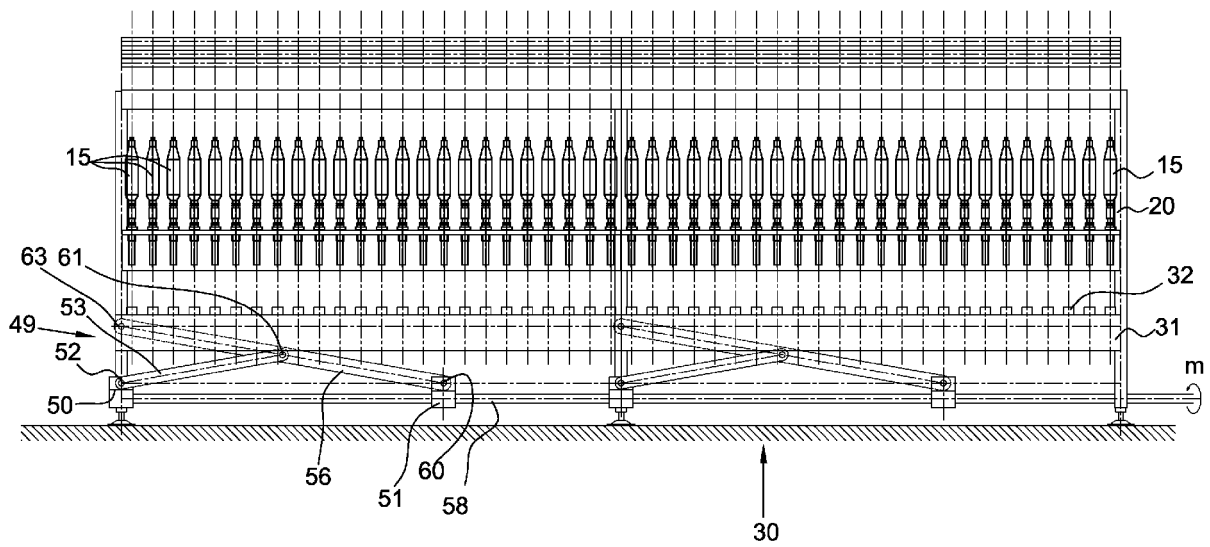


Fig. 4

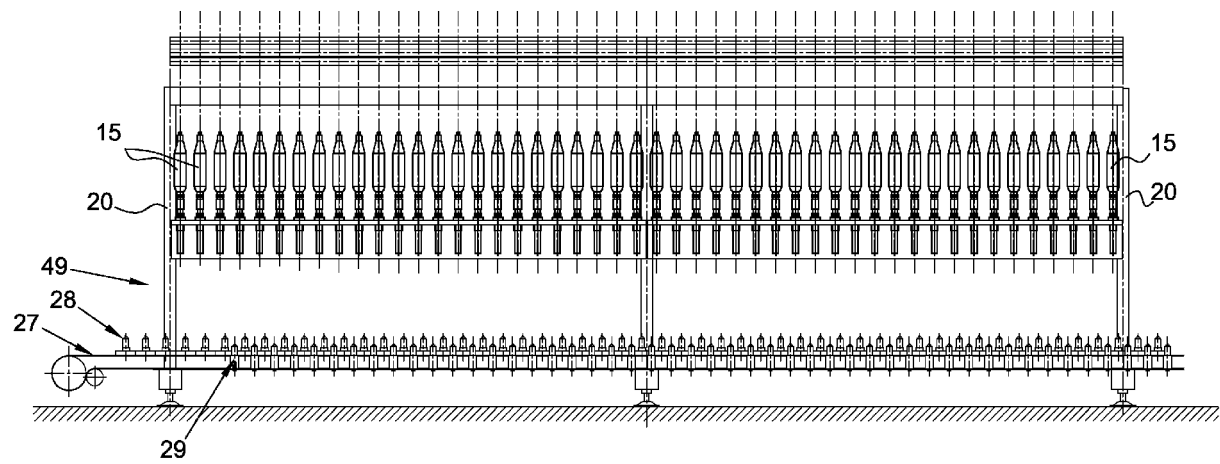


Fig. 5