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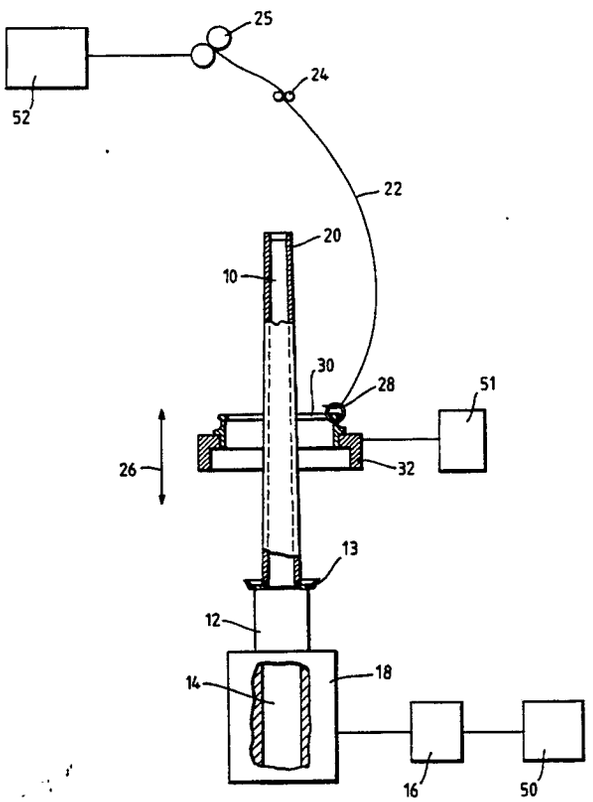
(54) Ring spinning, ring doubling and ring twisting frames.

(57) A textile machine of the ring spinning, ring doubling and ring twisting type having a switched reluctance spindle drive motor and set up to operate with a variable speed spindle and optionally with variable speed delivery rollers to wind yarn onto a package former in the form of a cop. A global control system is provided to instruct the local unit of the switched reluctance drive motor and possibly also control units of the delivery rollers.



EP 0 389 117 A2

RING SPINNING, RING DOUBLING AND RING TWISTING FRAMES

The present invention relates to the drive for a spindle of a textile machine of the ring frame type and especially to such a machine having a variable speed motor drive for winding a yarn strand onto a package former in the form of a cop. For example, the machine may be a ring spinner or a ring twister or a ring doubler, but in the present application the generic term "ring frame" will be used to denote this type of apparatus.

In order to ensure correct winding of the yarn strand onto the package former without breaking the yarn strand an unacceptable number of times during the winding operation and to complete a set of cops in the optimum time, hitherto the speed of the single prime moving motor arrangement applied to the ring frame has been variable to achieve variable speed winding conditions in that the said motor contains mechanical controls for the speed of the spindle during the cyclic build of the chase and the build of one complete set of cops.

The present invention aims to provide means for controlling the variable speed motor drive to such an apparatus accurately by means of a switched reluctance drive motor.

The apparatus of the present invention is characterised by the features of claim 1.

A switched reluctance drive motor, of the type disclosed in GB-A-1597486 can be controlled to operate in the required manner, and to provide a much more efficient control during operation.

The method of the present invention is characterised by the features of claim 4.

Other aspects of the present invention are covered in our co-pending EP-A- (corresponding to British Patent Application No. 8906712.8).

The following description is given merely by way of non-limitative example with reference to the accompanying drawing in which the sole Figure is a schematic diagram of one spindle position of a ring frame machine.

With reference to the drawing, a spindle 10 is connected to the motor shaft 14 of a switched reluctance drive motor 18, for example of the type in GB-A-1597486. In this embodiment the spindle is also fixedly attached to an annular member 12 carrying a yarn cutter 13. Control of the switched reluctance drive motor 18 is provided by means of a global control system 50.

A strand, in this case yarn 22, is delivered in the form of a balloon to a package former 20, through a pair of delivery rollers 25 and via a lappet 24 and a traveller 28 which is able to rotate on a ring 30 itself carried on a horizontal ring rail 32. The vertical movement of the ring rail 32 carrying the ring 30, as shown by the double headed arrows 26, is detected by a schematically illustrated sensor 51 which is linked to, or is part of, the global control system 50.

The two delivery rollers 25, which are preferably the last pair of drafting rollers of a drafting system (not shown) for drafting a yarn from roving, are controlled by a second control unit 52 which is also linked to, or is part of, the global control system 50.

In operation of the apparatus, the spindle 10 is set to rotate at a speed dictated by the global control system 50 in order to produce a cop build of yarn onto the package former 20. Yarn 22 is delivered through the traveller 28 and on to the package former 20.

The winding operation is controlled by the global control system 50 which controls the sequence of speed variation of delivery rollers 25 (by means of the control unit 52), the movement of the ring rail 32 (by means of the sensor 51), and also the rotation of the spindle through the switched reluctance drive motor 18 by means of the motor's own control unit 16.

It is common for such ring frames to have a common pair of delivery rollers 25 for the whole set of spindle positions and also a common drive unit to the ring rails 32 actuated from the prime mover of the ring frame. As a consequence, the delivery of yarn strand through the delivery rollers 25 is at the same rate for all positions, and the motions of the ring rails 32 at all the spindle positions are synchronized. It is therefore necessary to control the rotation of a spindle in accordance with the rotation of the delivery rollers 25 and the ring rail 32. This is particularly important during piecing, and for the period approaching doffing of a full set of cops, and immediately after doffing when starting to wind a new set of cops.

The build up of a package on the package former 20 is carried out with varying speed of the spindle supporting it, to ensure that an even tension is always applied to the yarn.

For example, at the beginning of each cop,when the yarn is being wound on to the empty package former 20, tension will be at its highest. It is therefore necessary to wind the yarn on at a slower than maximum speed. This is also the case when the package is nearing its measured length and the apex of the cop is being formed. At this point, it is necessary to reduce the winding speed of the spindle in order to keep the tension of the yarn as even as possible to ensure even quality throughout the yarn.

Similarly, in the middle portion of the cop, there will be variation in tension of the yarn strand

during the rise and fall of the ring rail, this being most acute when winding on the small diameter at the apex of each chase and then being gradually relieved as the ring rail is lowered and winding takes place on a larger diameter of the previous chase. Therefore, in adjusting the spinning speed throughout the build up of the cop, two distinct functions must be controlled. Firstly, there is the basic speed variation for the whole build up of the cop, starting and finishing at a lower speed and running at a corresponding higher speed for the main body of the cop. Secondly, there is the cyclic speed variation for each individual rise and fall of the ring rail governing the winding of the yarn on the conical shaped chase of the cop. The speed is reduced when winding on the apex of the chase (when the yarn is being wound onto the empty package former) and is increased when winding on the base of the previous chase (when winding is onto a large diameter and when there is a smaller tension).

Control of the speed variations is carried out by the global control system 50. Use of a switched reluctance drive motor in connection with such a control system allows accurate control of the speed of the spindle to be ensured at all times. Furthermore, since use of the switched reluctance drive motor enables stable rotation of the spindle at higher speeds it is possible, with such a global control system, to carry out the whole winding operation to create the cop in a shorter time than is possible with conventional machines.

Control from the global control system 50 can be either by a preset control pattern, or by, the global control system 50 being operated on a more active basis, that is by measuring the tension in the yarn at all times and adjusting the speed of the motor 18 accordingly.

The global control system 50 will also control the operation of the motor 18 by way of the local control unit 16 during the piecing and doffing operations.

If there is a yarn break at one of the spindle positions the local control unit 16 will stop the spindle from rotating and will instruct a required torque for that particular motor. This will be a rotation-resisting torque at a level adapted to assist in the piecing operation. Piecing can be carried out either manually (when the operator will use a switch to indicate to the local control unit 16 that it should start the package former 20 rotating again and to control this start-up in dependence upon the particular point in the cop build so as to resynchronize the spindle position with all the others of the machine), or automatically by means of a robot. In the case of automatic piecing, the piecing robot will find the spindle position requiring to be pieced and, with the aid of the local control unit 16, will execute a piecing cycle.

Similarly, during the doffing operation, the global control system 50 will send the appropriate control instructions to the local control units 16 to execute a shut-down sequence, and the control units 52 will stop delivery. This will be prompted by a signal from at least one of the sensors 51 of the ring frame that the cop has reached its measured length. Any suitable combination of the signals from the sensors 51 in the machine may be used to prompt the global control system 50 to terminate the winding operation ready for doffing.

Once the global control system 50 has thus determined that the cops have reached their measured length it instructs lowering of the ring rail 32 and, in this case, transfer of the yarn strand from the package former to the annular member 12 for storing, and for severing by the blade 13, in a known manner.

When the spindles have come to rest, the local control unit 16 applies a low rotation-resisting torque to be maintained until the instant of doffing.

For doffing, the global control system 50 will send a torque-selecting signal at a higher level to the local control units 16 of these motors to select the required rotation-resisting torque for each motor required when the packages are lifted to sever the yarn.

The rotation-resisting torque for the actual doffing operation will be substantially higher than the said low rotation-resisting torque which would suffice for the manual piecing operation, the latter being set to enable the operator to unwind a length of yarn from the package former with ease.

On insertion of the next empty package former 20 onto the spindle, the ring rail 32 is lifted again so that the yarn is taken up automatically onto the package former 20 and the winding operation can commence again immediately.

In an alternative embodiment, the ring rail lifting function may be carried out by a respective electric motor controlled by an electronic programmable logic controller (PLC) in accordance with a programme which resembles the conventional mode of ring rail lift but allows more accurate control of the build.

Claims

1. A ring frame (as herein defined) having a plurality of spindle positions each including:- a pair of delivery rollers (25), a ring (30) and traveller (28) assembly; a spindle (10) on which a package former (20) is placeable for winding a yarn thereonto; a drive motor (12) to drive said spindle; and a control system for said motor; characterised in that said motors are switched reluctance drive motors

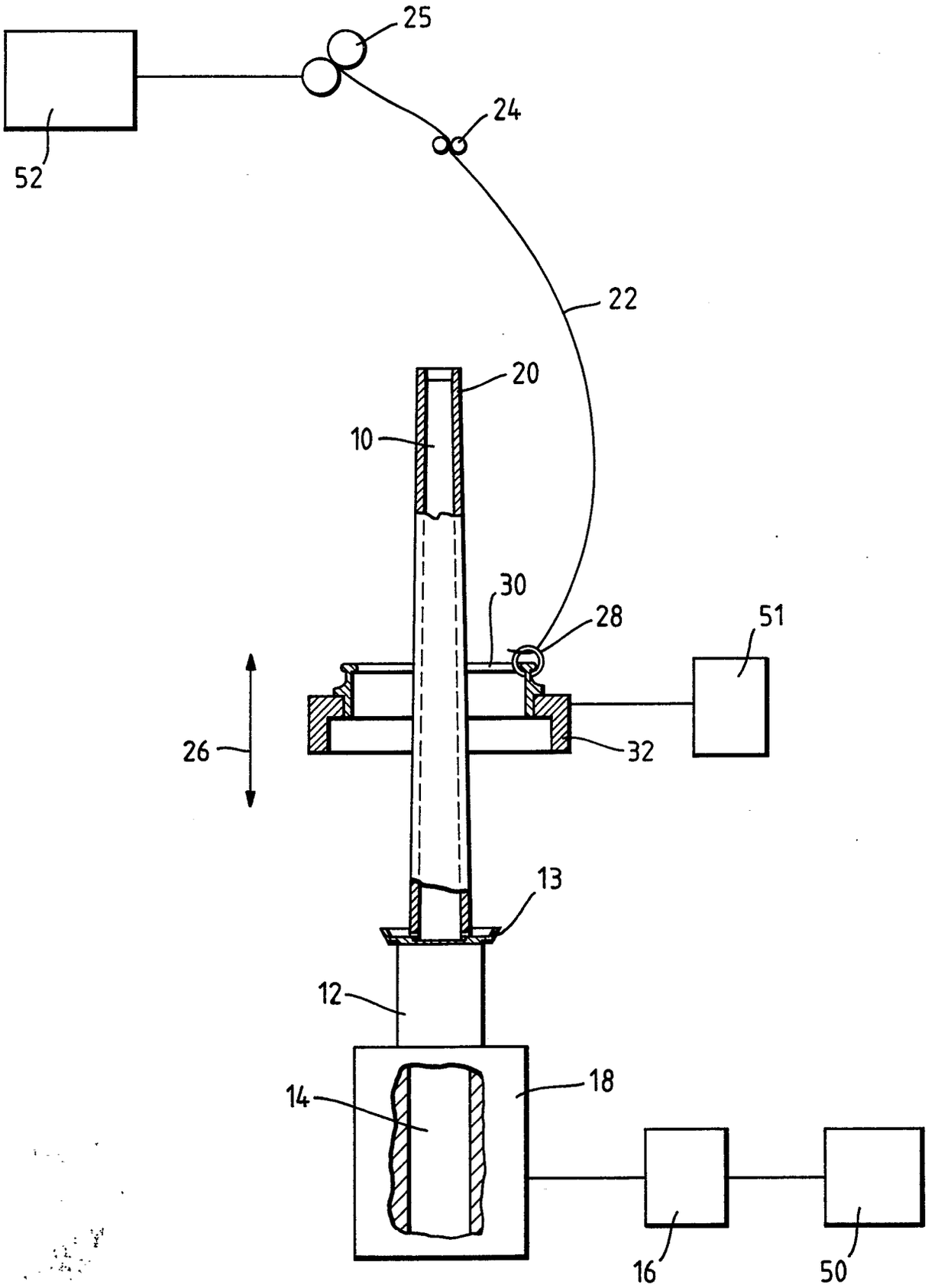
and in that said motor control system comprises a respective local control unit (16) for each said switched reluctance drive motor and a global control system (50) to instruct said local control units (16) to control said motors to operate in dependence on the operation of said delivery rollers and ring and traveller assembly.

2. A ring frame according to claim 1, characterised in that said global control system (50) is adapted to control each individual spindle position for variable speed spindle winding.

3. A ring frame according to either of the preceding claims wherein the ring and traveller assembly (28, 30) is not mechanically linked to the drive to the delivery rollers but is driven for axial movement along the spindle of its spindle position by an electric motor drivable at a varying speed.

4. A method of winding the yarn onto a package former in the form of a cop on a ring frame (as herein defined) having a plurality of spindle positions each including a pair of delivery rollers (25), a ring (30) and traveller (28) assembly, a spindle (10) on which a package former (20) is placeable for winding a yarn thereonto, an electric drive motor (12) to drive said spindle, and a control system for said motors, characterised by controlling each said motor (12) by means of a local control unit (16) to said motor, and controlling said local control units (16) by way of a global control system (50) to operate in dependence on the operation of said delivery rollers (25) and ring and traveller assembly (28, 30); in that said global control system both instructs a winding procedure for winding said yarn onto said cop and speed variation of said delivery rollers and instructs said ring and traveller assemblies to carry out the steps required in accordance with said procedure for winding said yarn; and in that said local control units are controlled by the global control system (50) to carry out winding of said yarn in accordance with said procedure.

5. A method according to claim 4, characterised in that said global control system (50) is programmed to instruct a lower speed of said drive motor at the start and finish of package winding than during the main part of the package winding, and is controlled to maintain substantially constant yarn tension throughout said package winding.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