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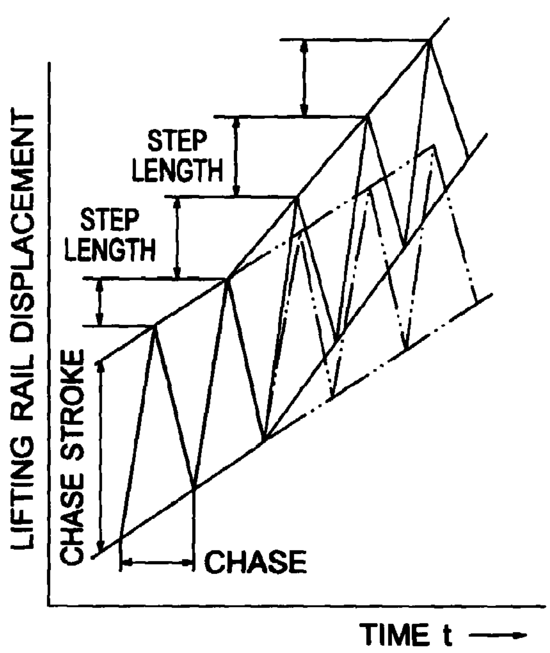
(54) Method of forming cop for spinning machine

(57) A cop forming method for a spinning machine wherein the method can protect the wind shape of a cop against deformation even when the spinning speed changes during the cop forming. The method of forming a cop in a spinning machine through up/down reciprocative motion of a ring rail for which a chase stroke, a chase speed, a step length and so forth have been set previously includes a step of correspondingly modifying the up/down reciprocative motion of the ring rail so that when the spinning speed becomes lower, the step length is increased correspondingly or the chase speed is increased correspondingly, while when the spinning speed becomes higher, the step length is decreased correspondingly or the chase speed is decreased correspondingly.

FIG. 1A



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method of forming a cop through cop winding or filling winding in a spinning machine, and particularly, in a ring spinning frame or a ring twisting frame. More particularly, the present invention is concerned with a cop forming method which allows a cop to be formed in an optimal shape by optimally controlling up/down reciprocative motion of a ring rail in the spinning machine.

Description of the Related Art

[0002] In order to have a better understanding of the present invention, the technical background thereof will first be reviewed. Heretofore, for taking up yarn on a bobbin in a ring spinning frame or a ring twisting frame, cop winding (or filling winding) has been widely adopted wherein yarn layers are formed sequentially around the bobbin in parallel thereto. In this case, a ring rail up/down reciprocative motion control program is prepared as represented by the broken lines in Figs. 1A and 2A in which time is taken along the abscissa with the height of the ring rail being taken along the ordinate. More specifically, the ring rail moves upwardly and downwardly at a predetermined chase length for every chase as a function of time with the turning point of the ring rail changing by a predetermined distance (i.e., by a predetermined step length).

[0003] Formation of the cop through such a cop winding as mentioned above suffers practically no problems so long as the spinning speed (or yarn delivery speed) of the spinning machine is constant. However, when the spinning speed changes in the course of formation of the cop, the spinning tension (i.e., tension applied to the yarn being delivered or spun) partially changes remarkably. Due to such a change of the spinning tension, the winding diameter of the cop also undergoes a corresponding change. Particularly, when the spinning speed becomes lower, the spinning tension decreases, and the outer diameter of a part of the cop increases, as indicated by the broken line images in Figs. 1B and 2B. In this conjunction, it is noted that when the outer diameter of the cop increases greatly due to the change of the spinning speed or spinning tension (tension applied to the yarn being spun), the outer peripheral surface of the swelled portion of the cop is likely to be brought into contact with the inner surface of the ring, which results in formation of a bar-like flaw in the cop. Such a flaw is known in the art as an abrasion. In order to protect the cop from the occurrence of such an abrasion, the winding diameter of the cop has to be previously set to be small when a change in the spinning speed is expected such as when changing a rove bobbin or traveller. Accordingly, the amount of yarn taken up on the bobbin for the cop will naturally decrease.

SUMMARY OF THE INVENTION

[0004] In light of the state of the art described above, it is an object of the present invention to provide a cop forming method for a spinning machine which can protect the winding shape of a cop against deformation, even when the spinning speed changes during the cop forming.

[0005] In view of the above and other objects which will become apparent as the description proceeds, the present invention is directed to a method of forming a cop in a spinning machine by up/down reciprocative motion of a ring rail for which a chase stroke, a chase speed, a step length and so forth have been set previously.

[0006] According to a general aspect of the present invention, the cop forming mentioned above is characterized by a step in which when a spinning speed changes during cop forming, the up/down reciprocative motion of the ring rail is correspondingly modified based on the change of the spinning speed.

[0007] At this juncture, the phrase "chase speed" used herein will be defined. The term "chase speed" is intended to mean the speed at which the ring rail moves over and along a chase stroke length.

[0008] In a preferred mode for carrying out the present invention, the step of modifying the up/down reciprocative motion of the ring rail should preferably be realized as a step of correspondingly changing the step length based on the change of the spinning speed.

[0009] Moreover, when the spinning speed becomes lower, the step length should preferably be increased, whereas when the spinning speed becomes higher, the step length should be decreased correspondingly.

[0010] In another mode for carrying out the invention, the step of modifying the up/down reciprocative motion of the ring rail should preferably be realized as a step of correspondingly changing the chase speed based on the change of the spinning speed.

[0011] Moreover, when the spinning speed becomes lower, the chase speed should preferably be increased, whereas when the spinning speed becomes higher, the chase speed should be lowered.

[0012] The above and other objects, features and attendant advantages of the present invention will more easily be understood by reading the following description of the preferred embodiments thereof taken, only by way of example, in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] In the course of the description which follows, reference is made to the drawings, in which:

Fig. 1A is a view illustrating displacement of a ring rail as a function of yarn take-up time in a cop forming method according to an embodiment of the present invention;

Fig. 1B is a view schematically showing the shape of a cop formed by taking up a yarn in the cop forming method according to the embodiment illustrated in Fig. 1A;

Fig. 2A is a view illustrating displacement of a ring rail as a function of yarn take-up time in a cop forming method according to another embodiment of the present invention;

Fig. 2B is a view schematically showing the shape of a cop formed by taking up a yarn in a cop forming method according to another embodiment of the invention illustrated in Fig. 2A;

Fig. 3 is a perspective view schematically showing a structure of a fine spinning frame for carrying out the cop forming method according to the present invention;

Fig. 4 is a side elevational view showing an up/down reciprocative motion mechanism of the fine spinning frame shown in Fig. 3;

Fig. 5 is a block diagram showing an arrangement of an electric/electronic control apparatus adopted in the fine spinning frame shown in Fig. 3;

Fig. 6 is a flow chart illustrating a procedure for setting one chase length and for setting a take-up length per chase in the fine spinning frame shown in Fig. 3;

Fig. 7 is a flow chart illustrating a procedure for reversibly changing the rotation of the fine spinning frame shown in Fig. 3; and

Fig. 8 is a view graphically illustrating a change of spinning speed as a function of time according to yet another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] The present invention will now be described in detail in conjunction with what is presently considered as a preferred or typical embodiment thereof with reference to the drawings. In the following description, like reference numerals designate like or corresponding parts throughout the drawings. Also in the following description, it is to be understood that such terms as "right", "left", "top", "bottom" and the like are words of convenience and are not to be construed as limiting terms.

Embodiment 1

[0015] The invention will now be described in detail with reference to the accompanying drawings. First, description will be directed to an apparatus employed for carrying out the present invention with reference to Figs. 3 to 7.

[0016] Referring to Fig. 4, a pair of line shafts 2 are disposed and mounted rotatably so as to extend in parallel with the longitudinal direction of a machine frame at an inner side of spindle rails 1.

[0017] As shown in Fig. 3, a driving gear 3 and a bevel gear 4 are mounted on the line shaft 2 so as to be rotatable together therewith. Referring to Fig. 4, a poker pillar 6 which supports a ring rail 5 is vertically and slideably journaled on the spindle rail 1 through a slide guide 7. Furthermore, a nut member 8 is supported rotatably on the spindle rail 1 by a bearing 9 at a position beneath the slide guide 7. A screw portion (thread portion) 6a is formed on the poker pillar 6 at a lower end portion thereof to screwably engage with the nut member 8. A driving gear 10 is mounted on the nut member 8 at a lower end thereof so as to mesh with the driving gear 3.

[0018] On the other hand, a poker pillar 12 which supports a lappet holding angle bar 11 (see Fig. 3) is vertically and slideably supported relative to the machine frame through a slide guide (not shown). Further, the poker pillar 12 is supported rotatably relative to the machine frame by means of a bearing (not shown). A nut member 13 screwably engages with a screw portion 12a formed at a lower end portion of the poker pillar 12. A bevel gear 14 is mounted on the nut member 13 at a lower end thereof so as to mesh with the bevel gear 4 mounted on the line shaft 2.

[0019] Referring to Fig. 3, a line shaft driving system 15 is designed to drive both the line shafts 2 forwardly or reversely. Also, it should be mentioned that the line shaft driving system 15 is formed independently of a spindle/draft portion driving 17 system including a driving shaft (tape pulley shaft) 16 which is driven by a main motor (not shown). A rotary encoder 30 is provided for detecting rotation of the driving shaft 16.

[0020] The line shaft driving system 15 includes an intermediate shaft 18 which is mounted rotatably between both the line shafts 2 and extends in parallel therewith. Mounted at one end of the intermediate shaft 18 is a gear 21 which meshes with a gear 20 secured to an output shaft 19 of a lifting motor M. A rotary encoder 22 is mounted at the other end portion of the intermediate shaft 18 for detecting the number of revolutions (rpm) of the intermediate shaft 18.

[0021] A rotatable shaft 23 is disposed so as to extend in the direction orthogonal to the line shaft 2. A worm wheel 24 is mounted on the rotatable shaft 23, and a worm 25 which meshes with the worm wheel 24 is mounted on the intermediate shaft 18. Bevel gears 27 are mounted on the rotatable shaft 23 at both ends thereof, respectively, wherein each of the bevel gears 27 is adapted to mesh with a bevel gear 26 mounted on the line shaft 2 at one end portion thereof.

[0022] As the lifting motor M, a variable speed reversible motor such as a servo motor or the like may be employed. This lifting motor M is driven under the control of a control unit 28 and a speed change control unit

29. Detection signals derived from the outputs of the rotary encoders 22 and 30 are supplied to the control unit 28.

[0023] Next, referring to Fig. 5, description will turn to the control circuit for driving the lifting motor M. A microcomputer 31 which constitutes a major part of the control unit 28 is composed of a central processing unit 32 (hereinafter referred to as the CPU), a program memory 33 constituted by a read-only memory (ROM) for storing a control program or programs, and a rewritable memory (random access memory or RAM) adapted for temporarily storing results of arithmetic processing and the like executed by the CPU. The CPU 32 operates in accordance with program data stored in the program memory 33.

[0024] Provided in combination with the control unit 28 is an input device 35 in the form of a keyboard which serves for inputting to the work memory 34 conditions for a cop building motion for forming the cop such as a single lift quantity (chase stroke), a single winding quantity (step length), a moving speed upon up- or down-motion and the like. Moreover, it should be mentioned that there is an optimum moving speed which corresponds to the actual yarn count and the actual number of revolutions (rpm) of the spindle. The CPU 32 is programmed so as to arithmetically determine the up/down standard speed for moving the ring rail 5 up and down, i.e., the standard rotational speed (rpm) of the lifting motor M on the basis of the yarn count input before the frame operation is started and the number of revolutions arithmetically determined on the basis of an output signal of the rotary encoder 30, to thereby generate a control signal for the lifting motor M on the basis of the rotational speed, the control signal then being output to the lifting motor M. The number of revolutions of the spindle can be arithmetically determined on the basis of the detected rotational speed of the tape pulley shaft 16. Alternatively, the number of revolutions of the spindle may be arithmetically determined on the basis of the detected rotational speed of a front roller.

[0025] The CPU 32 is programmed to generate a command signal for the speed change control unit 29 on the basis of the operating conditions input through the input device 35 and the output signals of the rotary encoders 22 and 30 to thereby control the lifting motor M by way of the speed change control unit 29.

[0026] Next, description will be made of operation of the apparatus configured in the structure described above. In response to the operation command issued by the control unit 28, the speed change control unit 29 rotationally drives the lifting motor M in the forward direction. When the lifting motor M rotates in the forward direction, both the line shafts 2 are caused to rotate in the forward direction by way of the output shaft 19, the gears 20 and 21, the intermediate shaft 18, the worm 25, the worm wheel 24, the rotatable shaft 23 and the bevel gears 26 and 27. Upon forward rotation of the line shafts 2, the driving gear 3 and the bevel gear 4 are also caused to rotate in the forward direction. Under the action of the driving gear 10 and the bevel gear 14, which mesh with the driving gear 3 and the bevel gear 4, respectively, the nut members 8 and 13 are brought into rotation. Furthermore, under the action of the screw portions 6a and 12a which screwably engage with the nut members 8 and 13, respectively, the poker pillars 6 and 12 are caused to move upwardly together with the ring rail 5 and the lappet holding angle bar 11, respectively. The lift quantity or stroke of the ring rail 5 is detected by the rotary encoder 22 mounted on the intermediate shaft 18, whereby a pulse signal corresponding to the lift quantity or stroke is input to the control unit 28. Moreover, the relationship between the lift quantity or stroke and the pulse number is determined on the basis of the number of revolutions of the intermediate shaft 18, speed reduction ratios in the transmission paths extending from the intermediate shaft 18 to the screw portions 6a and 12a, respectively, and the number of pulses generated by the rotary encoder 22 during a period corresponding to one complete rotation.

[0027] Referring to a flow chart shown in Fig. 6, the control unit 28 sets up a pulse number NF which corresponds to a single chase length or stroke which is determined arithmetically, and stored, on the basis of the single lift quantity or stroke (chase stroke) C input into the work memory prior to operation (steps 1 and 2), and then sets up a pulse number NR corresponding to a stored value (C - F) determined on the basis of the value of the take-up amount F for every chase (steps 3 and 4). By using to these pulse numbers NF and NR as a reference, the control unit 28 controls the driving operation of the lifting motor M in accordance with a processing procedure illustrated in the flow chart of Fig. 7.

[0028] Upon starting the spinning machine, the control unit 28 counts the number of pulses output from the rotary encoder 22 (step 5) and determines whether or not the ring rail 5 is moving upwardly, i.e., whether or not the lifting motor M is rotating in the forward direction (step 6). Further, the control unit 28 constantly compares the detected pulse number and the preset pulse number NF with each other (step 7). In the state where the lifting motor M is rotating forwardly (i.e., when step 6 is "YES"), the control unit 28 issues a reverse rotation command to the speed change control unit 29 (step 8) at a point in time when the accumulated value N of the detected pulses becomes equal to the preset pulse number NF (i.e., when step 7 is "YES"). In response to the reverse rotation command, the speed change control unit 29 reverses the rotational direction of the lifting motor M. When the lifting motor M is driven in the reverse rotational direction in this way, the line shaft 2 is caused to rotate in the reverse direction, and the poker pillars 6 and 12 are moved downwardly together with the ring rail 5 and the lappet holding angle bar 11, respectively.

[0029] The control unit 28 restarts counting the number of detection pulses output from the rotary encoder 22 at a point in time when the reverse rotation command is issued to the speed change control unit 29 (step 5). Since the lifting motor M has already been driven in the reverse direction (when step 6 is "NO"), the accumulated value of the detection pulses is compared with the preset pulse NR (step 9). The control unit 28 reissues the reverse rotation command to the speed change control unit 29 (step 10) at a point in time when the accumulated value N becomes equal to the preset pulse number NR (i.e., when step 9 is "YES"). In response to the reverse rotation command, the speed change control unit 29 drives the lifting motor M in the forward direction, whereby the ring rail 5 is lifted (moved upwards) again.

[0030] In this way, the ring rail 5 and the lappet holding angle bar 11 are caused to move upwardly gradually or stepwise while repetitively undergoing upward/downward movement in unison with the poker pillars 6 and 12, whereby a cop winding (filling winding) is performed to form the cop.

[0031] Now, the present invention will be described in detail in conjunction with changing the rove bobbin in the ring twisting or spinning frame. When the rove bobbin is to be changed in the fine spinning frame without lowering the spinning speed (or rove delivering speed), a knot formed upon rove tying after changing the rove will become untied or loosened under the action of a centrifugal force applied upon whirling of the knot, leading to a failure of the rove change. Accordingly, especially upon changing of the rove bobbin in the automated machines, the spinning speed (or rove delivering speed) has to be lowered to about 70 % of the normal speed. In that case, the spinning speed of all the spindles in the machine frame for which the rove bobbin has to be changed are concurrently lowered, whereupon the rove bobbin is changed manually or with the aid of a rove bobbin exchanging machine on a spindle-by-spindle basis.

[0032] When the spinning speed of the spinning frame is lowered in this way and the previously mentioned cop forming is carried out as such, swelling will occur on the outer peripheral surface of the cop because of change of the spinning tension, i.e, tension applied to the rove being spun, as indicated by the broken lines in Figs. 1B and 2B.

[0033] The cop having the swelled portion on its outer peripheral surface as mentioned above is likely to be brought into frictional contact with the inner surface of the ring, resulting in formation of a bar-like flaw or abrasion in the outer surface of the cop. Needless to say, a cop having such an abrasion has to be eliminated as a defective one.

[0034] Hence, in the cop forming method according to a first embodiment of the present invention illustrated in Figs. 1A and 1B, when lowering of the spinning speed is detected, or alternatively, when the conditions preset in a computer indicating the lowering of the spinning speed are met, the step length is set to a greater value than the step length in ordinary take-up while keeping the chase stroke and the chase speed constant, as indicated by a solid-line pattern in Fig. 1A. Consequently, the yarn is taken up over a wider range of the cop, preventing the cop diameter from increasing locally.

[0035] It is noted that the step length in ordinary rove take-up differs depending on the thickness of the yarn. However, in general, the step length is set within a range of 40 to 50 mm. In this case, the change of the step length which occurs in carrying out the cop forming method according to the instant embodiment of the invention is at most on the order of 1 mm. Generally, the partial swelling of the cop can be prevented by increasing the step length about 5 to 10 %.

[0036] As can be appreciated from the foregoing, according to the teachings of the present invention it is possible to prevent the cop taking up the yarn from partially swelling abnormally. That is, the so-called abrasion phenomena due to the swelling of the cop can be prevented. In this way, the yarn can be taken up to an ordinary cop diameter notwithstanding a change in the spinning speed due to the rove bobbin change during yarn take-up operation (cop forming).

[0037] In the case of the cop forming method described above, the cop shape is optimized by increasing the step length without changing the chase speed when the spinning speed becomes lower. However, as another cop forming method according to the present invention, it is equally possible to change the chase speed while maintaining the step length constant to substantially the same effect, as illustrated by solid-lines in Figs. 2A and 2B. With this method, the partial swelling of the cop can be prevented by increasing the chase speed when the spinning speed becomes lower, whereby an ordinary cop diameter can be realized. Moreover, the time taken for the yarn to move along the chase stroke is usually set to lie within a range of ten seconds to one minute although it depends on the type of the yarn. The magnitude of the time change should preferably be suppressed to 10 % or less when compared with that of the ordinary cop forming operation.

[0038] As a modification, it is conceivable to combine the cop forming methods described above. More specifically, upon lowering the spinning speed, both the step length and the chase speed can be increased.

[0039] Although the foregoing description has been made when the spinning speed becomes lower, it goes without saying that the present invention can equally apply when the spinning speed increases. In other words, when the spinning speed becomes higher, the step length or the chase speed or both can be decreased to prevent the cop from partially swelling.

[0040] At this juncture, it should also be mentioned that in cop winding, the spinning speed is increased to an ordinary speed from the start of the cop winding, whereon the cop is formed at an ordinary constant spinning speed, and the spinning speed is decreased to zero from the constant speed upon completion of the cop forming. Nevertheless, it should be noted that the teachings of the invention can equally be applied when the spinning speed is to be changed during ordinary cop winding. In this case, the cop diameter can be maintained constant by controlling the cop winding in accordance with the teachings of the present invention.

[0041] As is apparent from the foregoing description, the yarn can be taken up such that the optimum cop shape can be realized. In other words, the cop can be formed with optimum shape without suffering an abrasion or like flaw due to frictional contact with the inner surface of the ring. Thus, the cop having a large diameter can be manufactured properly without creating any defective products.

[0042] In the foregoing, the embodiment of the present invention which is considered preferable at present and other alternative embodiments have been described in detail with reference to the drawings. It should, however, be noted that the present invention is never restricted to these embodiments but other various applications and modifications of the cop forming method for the spinning machinery can be easily conceived and realized by those skilled in the art without departing from the spirit and scope of the present invention.

Claims

1. A method of forming a cop in a spinning machine through up/down reciprocative motion of a ring rail for which a chase stroke, a chase speed, a step length and the like have been previously set, comprising a step of:

correspondingly modifying the up/down reciprocative motion of said ring rail based on a change of said spinning speed when said spinning speed changes during a cop forming.

2. A cop forming method according to claim 1, wherein said step of modifying the up/down reciprocative motion of said ring rail includes a step of correspondingly changing said step length based on the change of said spinning speed.

3. A cop forming method according to claim 2, wherein when said spinning speed becomes lower, said step length is increased, whereas when said spinning speed becomes higher, said step length is decreased correspondingly.

4. A cop forming method according to claim 3, wherein the increase or decrease of said step length falls within a range of length of substantially 10 % of an ordinary step length.

5. A cop forming method according to claim 1, wherein said step of modifying the up/down reciprocative motion of said ring rail further includes a step of correspondingly changing said chase speed based on the change of said spinning speed.

6. A cop forming method according to claim 5, wherein when said spinning speed becomes lower, said chase speed is increased, whereas when said spinning speed becomes higher, said chase speed is lowered.

7. A cop forming method according to claim 6, wherein the increase or decrease of said chase speed falls within a range of speed of substantially 10 % of an ordinary chase speed.

8. A cop forming method according to claim 1, wherein said step of modifying the up/down reciprocative motion of said ring rail includes a step of correspondingly changing said step length and said chase speed based on the change of said spinning speed such that when said spinning speed becomes lower, said step length is increased with said chase speed also being increased, whereas when said spinning speed becomes higher, said step length is decreased with said chase speed also being decreased.

FIG. 1A

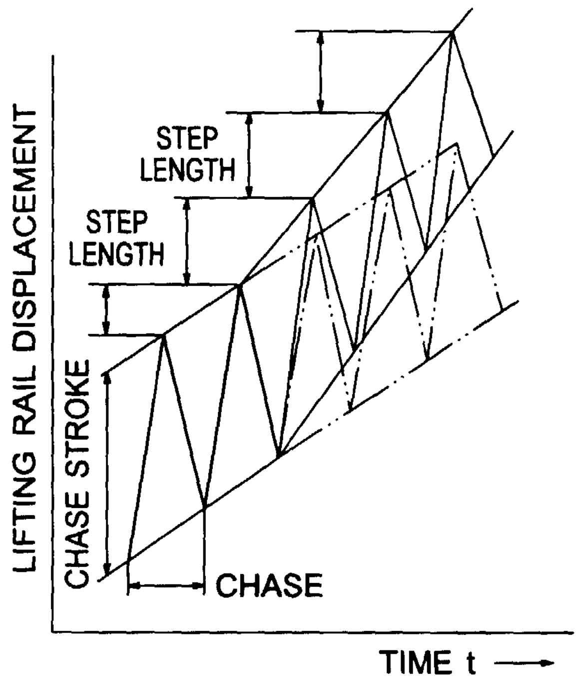


FIG. 1B

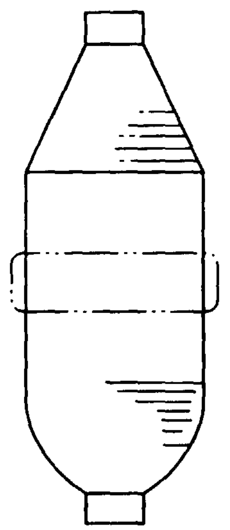


FIG. 2A

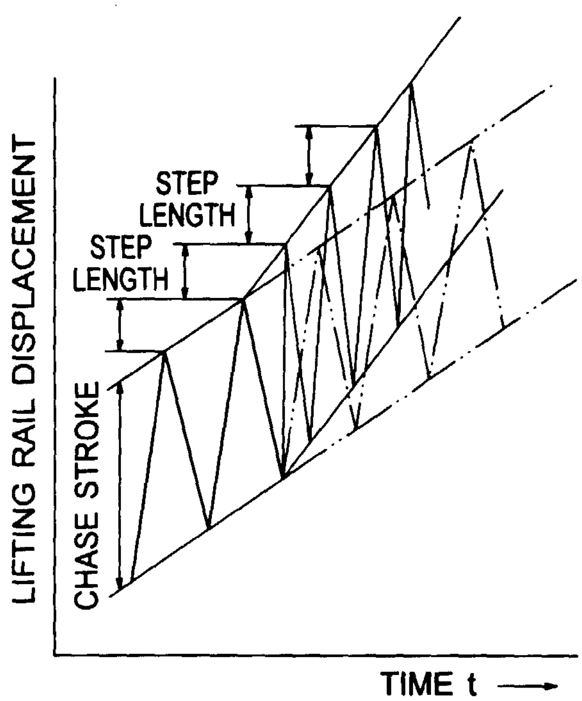


FIG. 2B

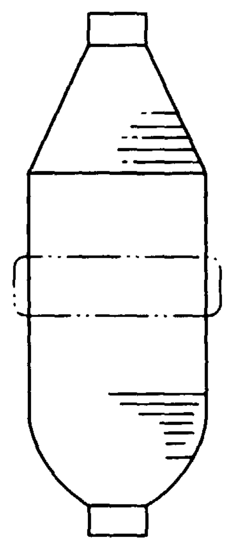
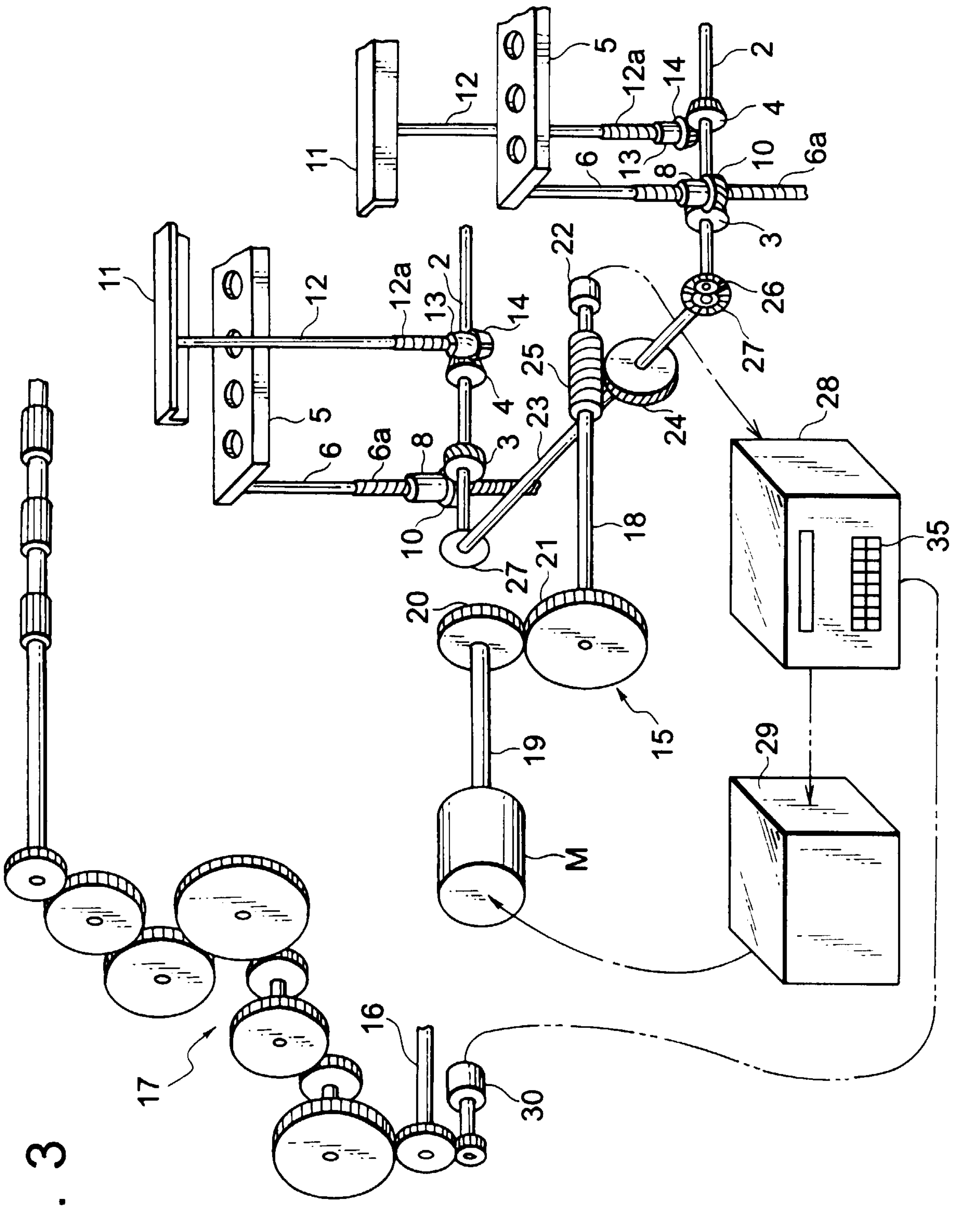


FIG. 3


2
3
4
5
6
6a
8
10
11
12
12a
13
14
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22
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30
35
M

FIG. 4

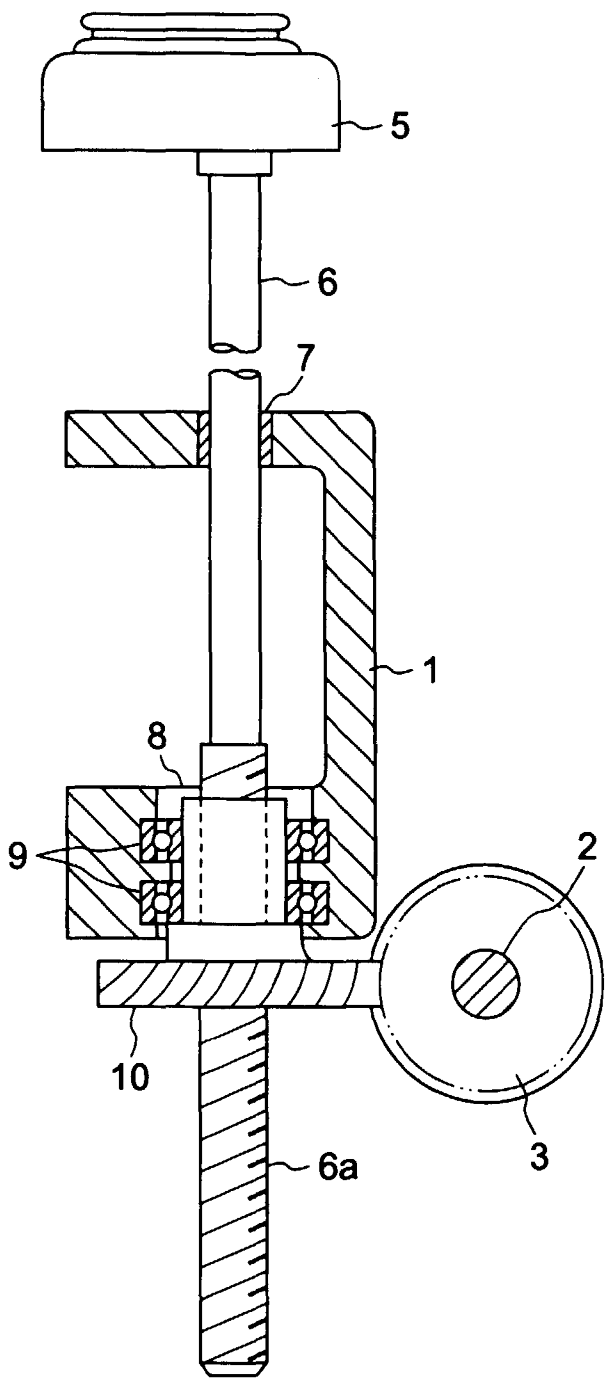


FIG. 5

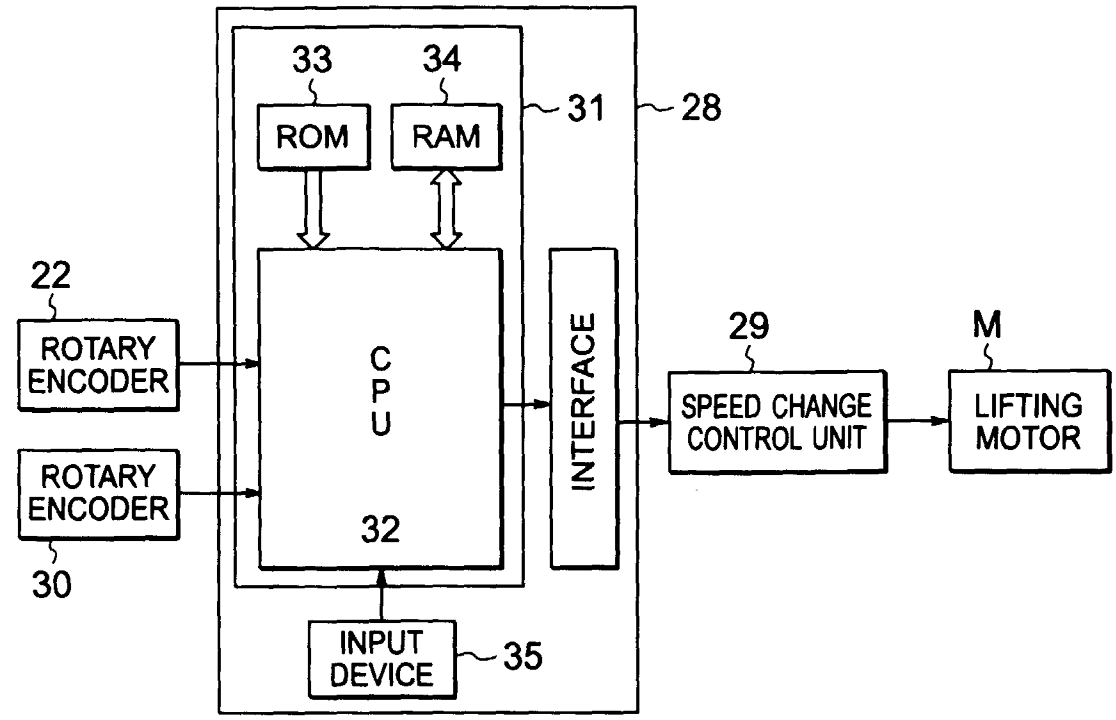

33
34
ROM
RAM
31
28
22
ROTARY ENCODER
C P U
INTERFACE
29
M
SPEED CHANGE CONTROL UNIT
LIFTING MOTOR
ROTARY ENCODER
32
30
INPUT DEVICE
35

FIG. 6

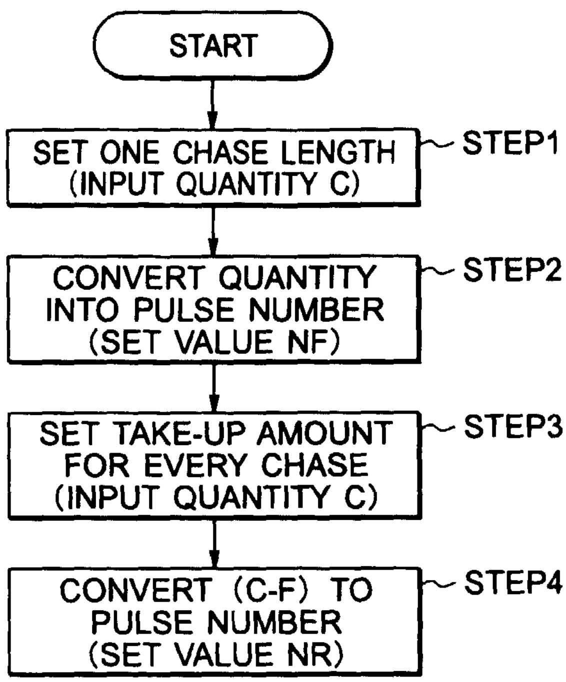

START
SET ONE CHASE LENGTH (INPUT QUANTITY C)
STEP1
CONVERT QUANTITY INTO PULSE NUMBER (SET VALUE NF)
STEP2
SET TAKE-UP AMOUNT FOR EVERY CHASE (INPUT QUANTITY C)
STEP3
CONVERT (C-F) TO PULSE NUMBER (SET VALUE NR)
STEP4

FIG. 7

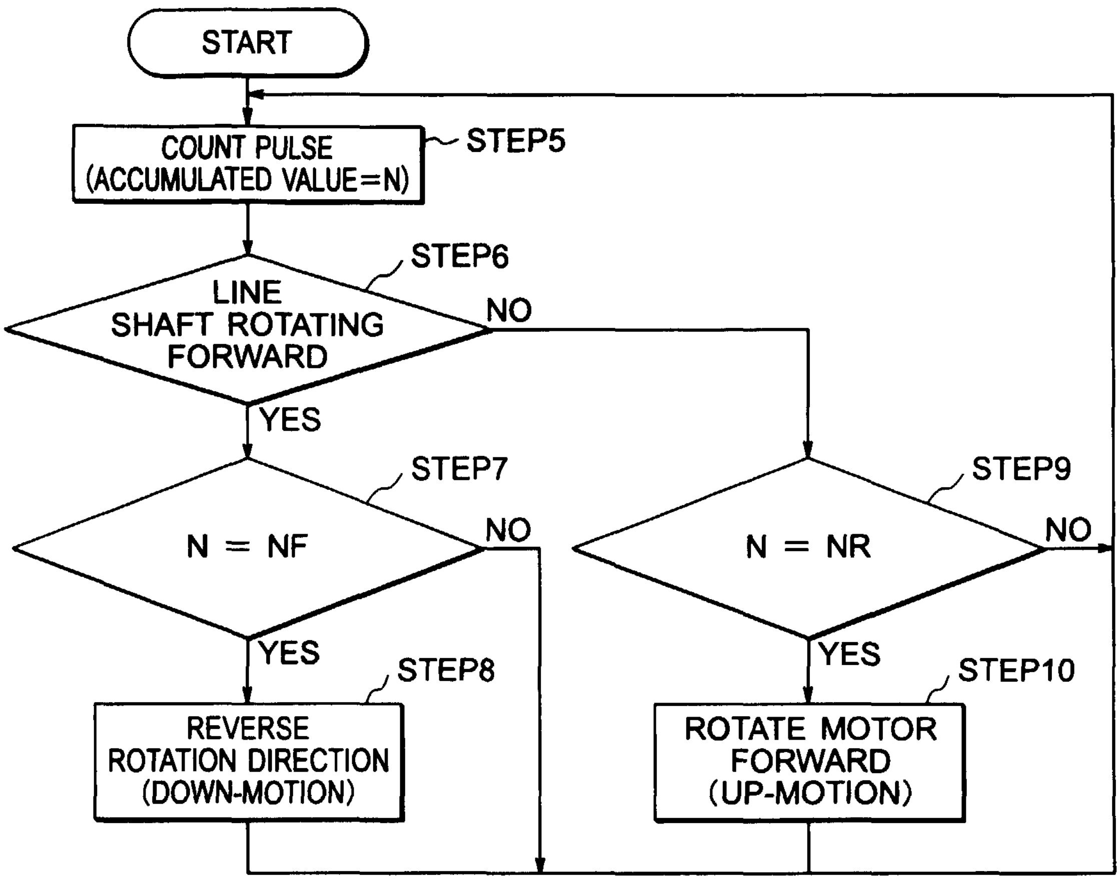
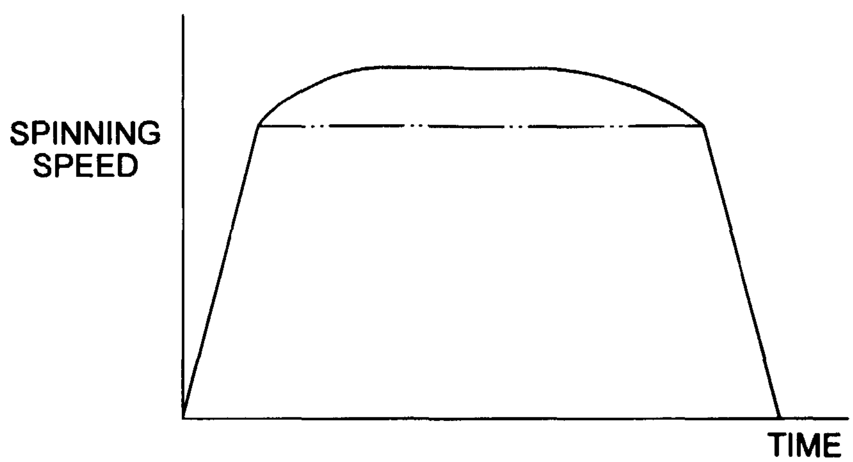

START
COUNT PULSE (ACCUMULATED VALUE=N)
STEP5
STEP6
LINE SHAFT ROTATING FORWARD
NO
YES
STEP7
N = NF
NO
YES
STEP8
REVERSE ROTATION DIRECTION (DOWN-MOTION)
STEP9
N = NR
NO
YES
STEP10
ROTATE MOTOR FORWARD (UP-MOTION)

FIG. 8


SPINNING SPEED
TIME