

[54] **AUTOMATIC REEL EXCHANGING DEVICE
FOR A WINDING APPARATUS**

[75] Inventor: **Asko Sakari Riekkinen**, Kauniainen,
Finland

[73] Assignee: **Oy Nokia AB**, Helsinki, Finland

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1969, abandoned, and Ser. No. 159,636, July 6,
1971, abandoned.

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[51] Int. Cl. **B21c 47/24**

[58] Field of Search **242/79, 81, 35.5; 57/52**

[56]

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Primary Examiner—John W. Huckert

Assistant Examiner—Milton S. Gerstein

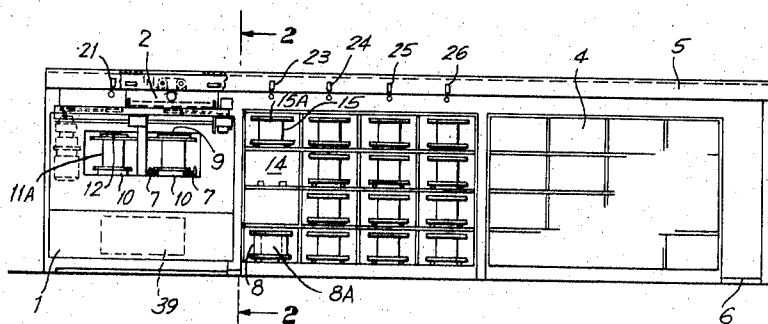
Attorney, Agent, or Firm—Waters, Roditi, Schwartz &
Nissen

[57]

ABSTRACT

A reel exchanging device for a winding apparatus for thread-like or ribbon-like material comprising a movable reel conveying arrangement which is programmed to carry out the reel conveying operations automatically synchronous with the winding operation of the winding apparatus.

4 Claims, 13 Drawing Figures



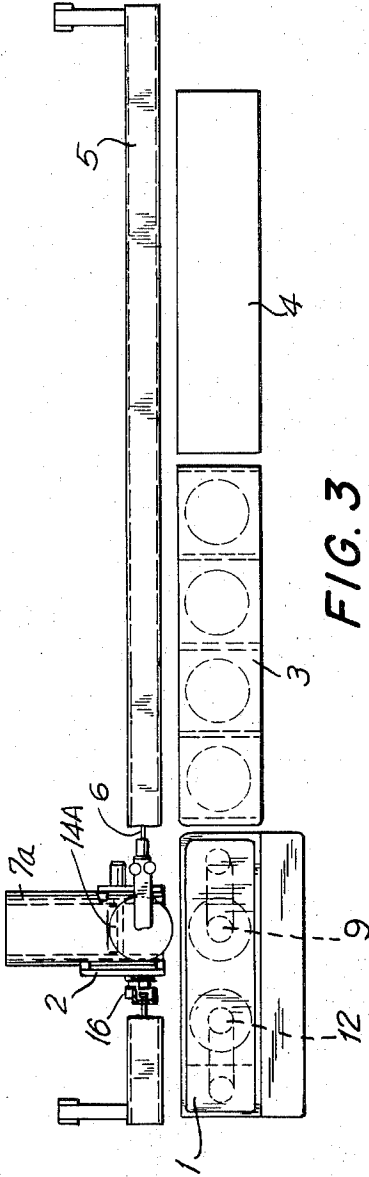
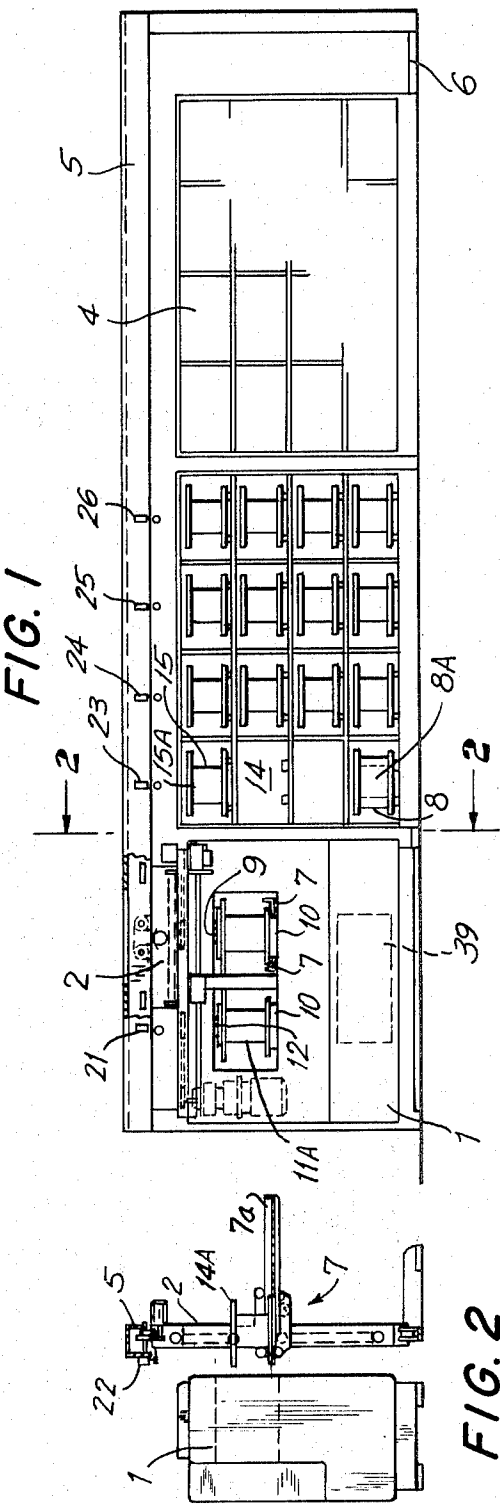


FIG. 6

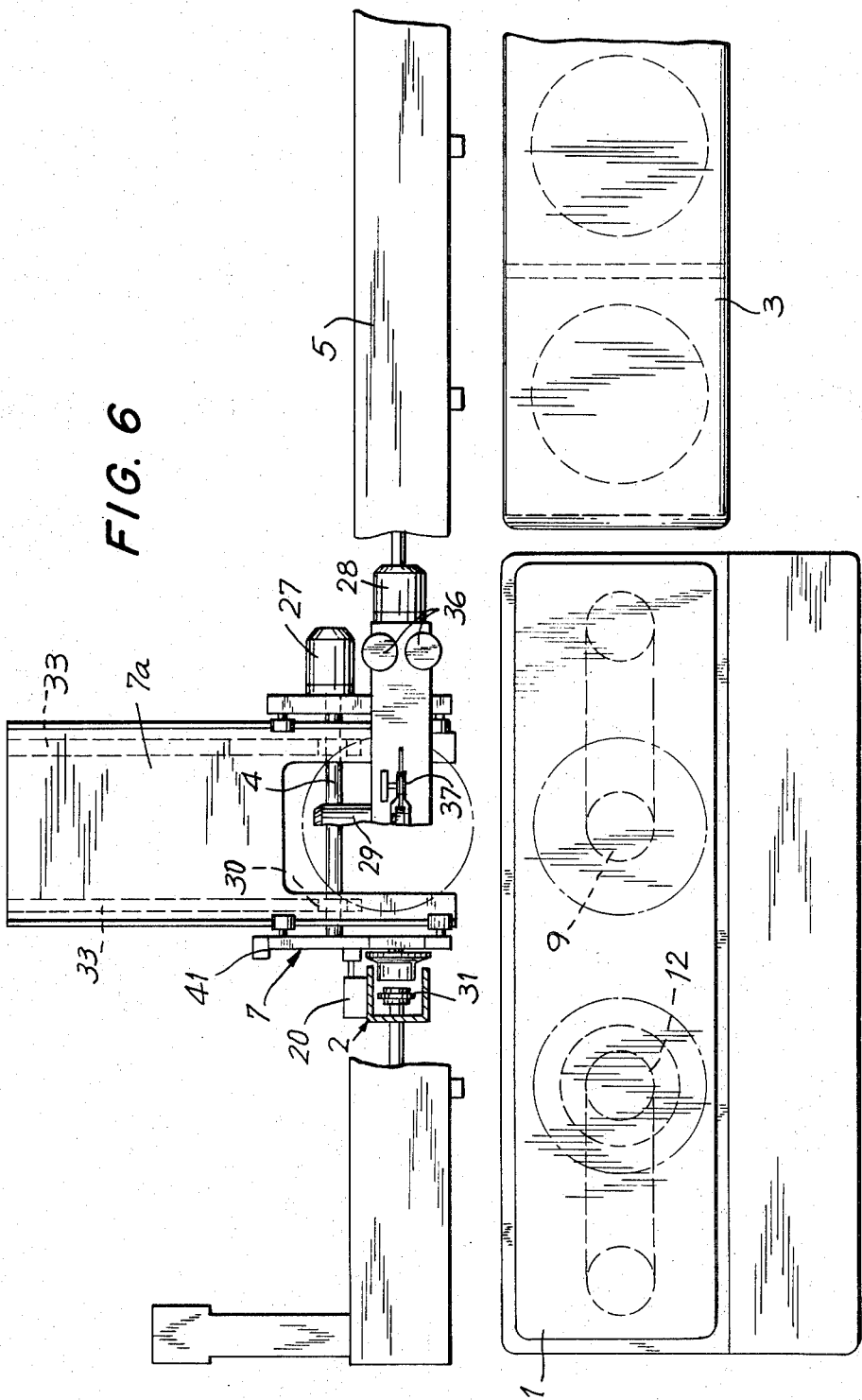


FIG. 7

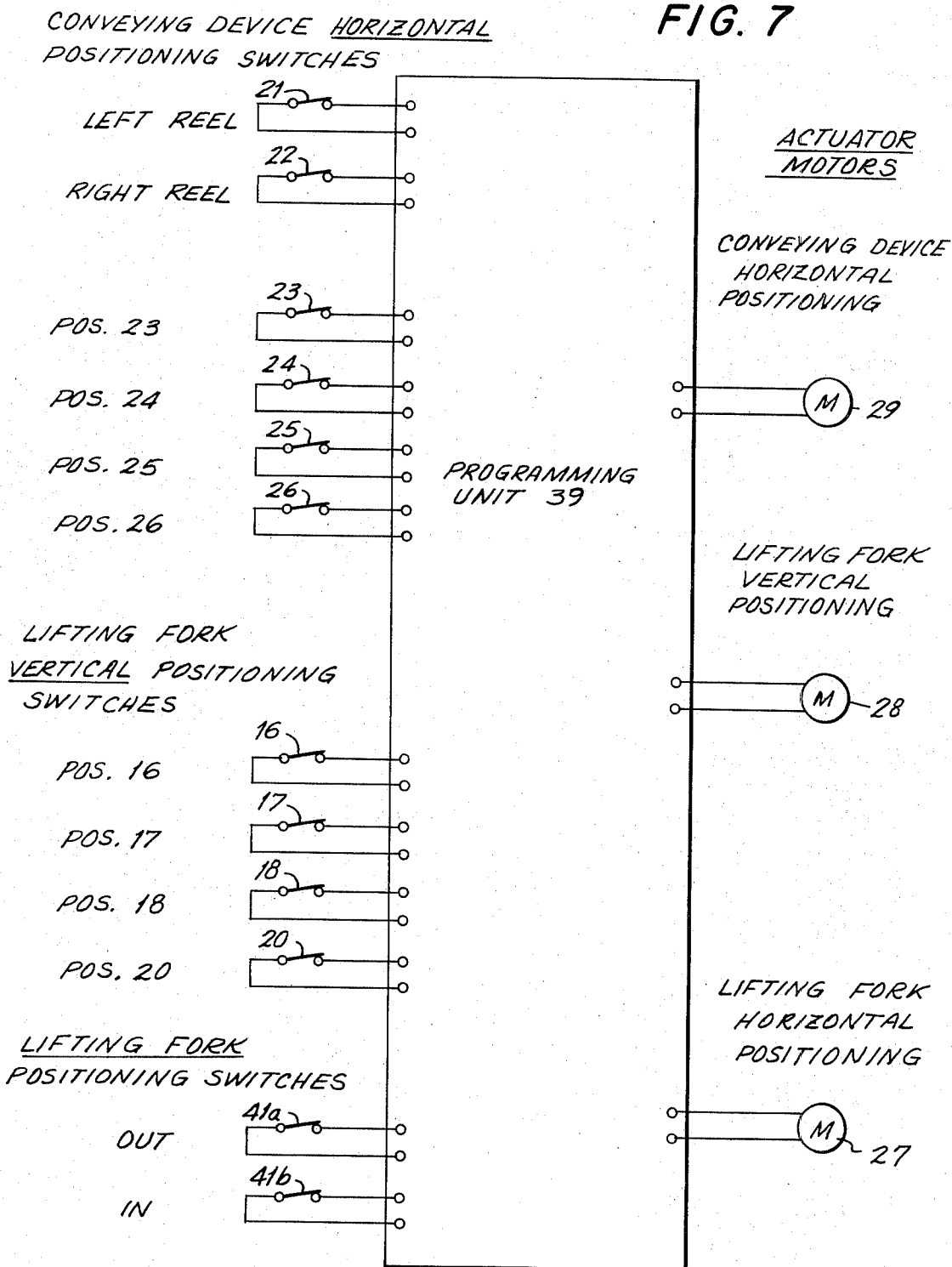


FIG. 8

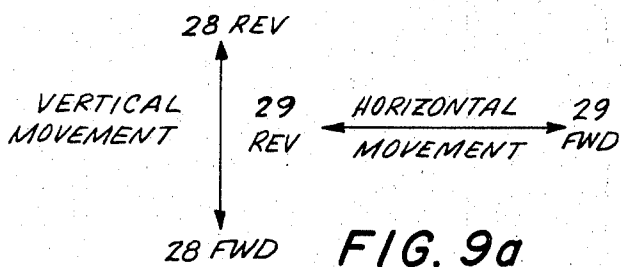
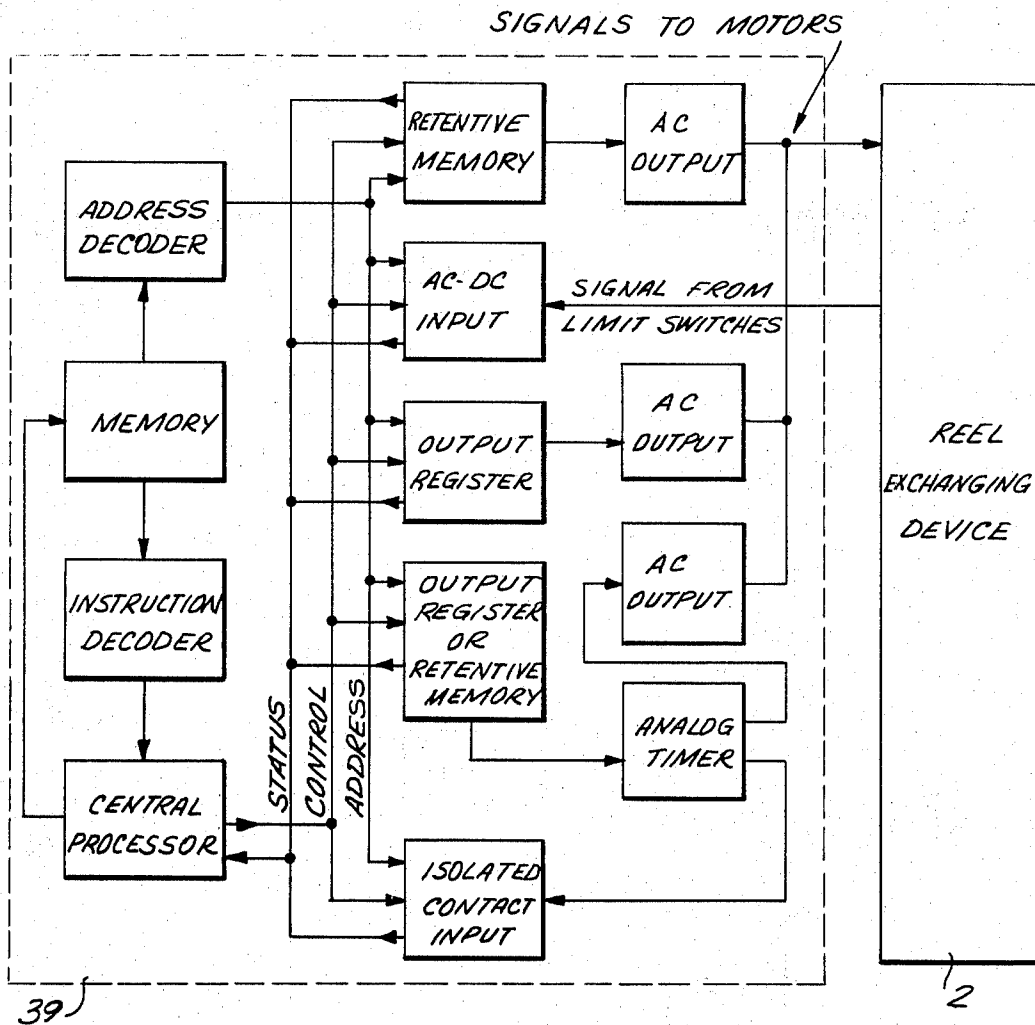


FIG. 9a

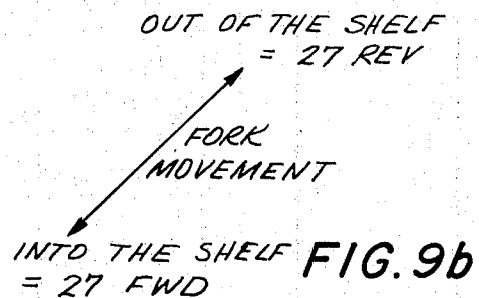


FIG. 9b

FIG. 10a

THE CONVEYING DEVICE
STARTS FROM THE RIGHT
SIDE OF THE "BOOK SHELF"

THE FORK HAS REACHED THE
RIGHT POINT (23, 16)

THE FORK GOES UNDER
AN EMPTY REEL

THE FORK IS LIFTED A
FEW CENTIMETERS

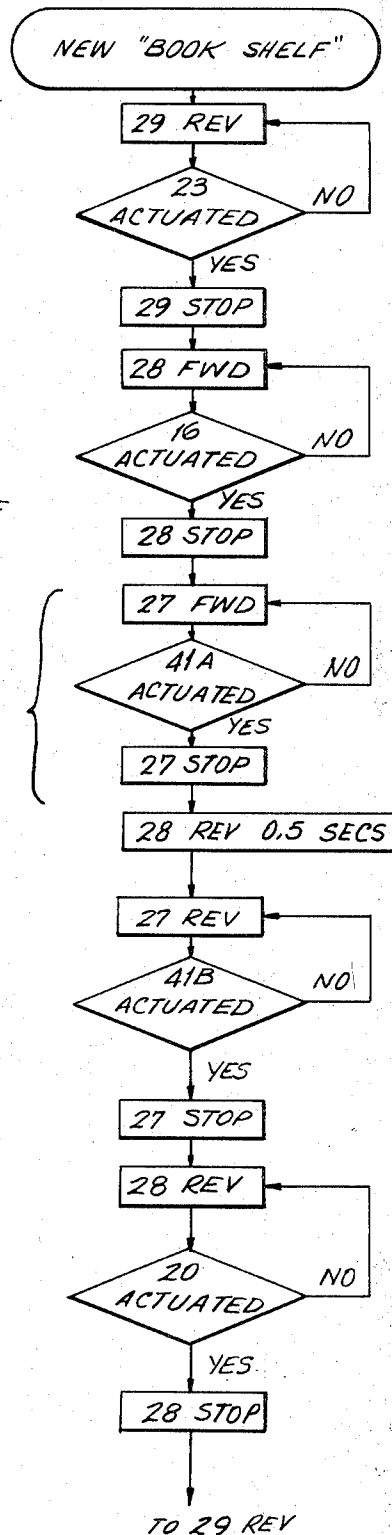


FIG. 10b

AN EMPTY REEL IS NOW READY
TO BE PUSHED IN THE WINDER,
LEFT SIDE

SENDS THE WINDER A PULSE
"LOCK THE REEL"

SENDS THE WINDER A PULSE
TELLING "REEL CHANGE
HAS BEEN PERFORMED"

THE WINDER GIVES A PULSE
IT WANTS THE RIGHT REEL
TO BE CHANGED.

THE WINDER GETS A SIGNAL
TO RELEASE THE FULL REEL

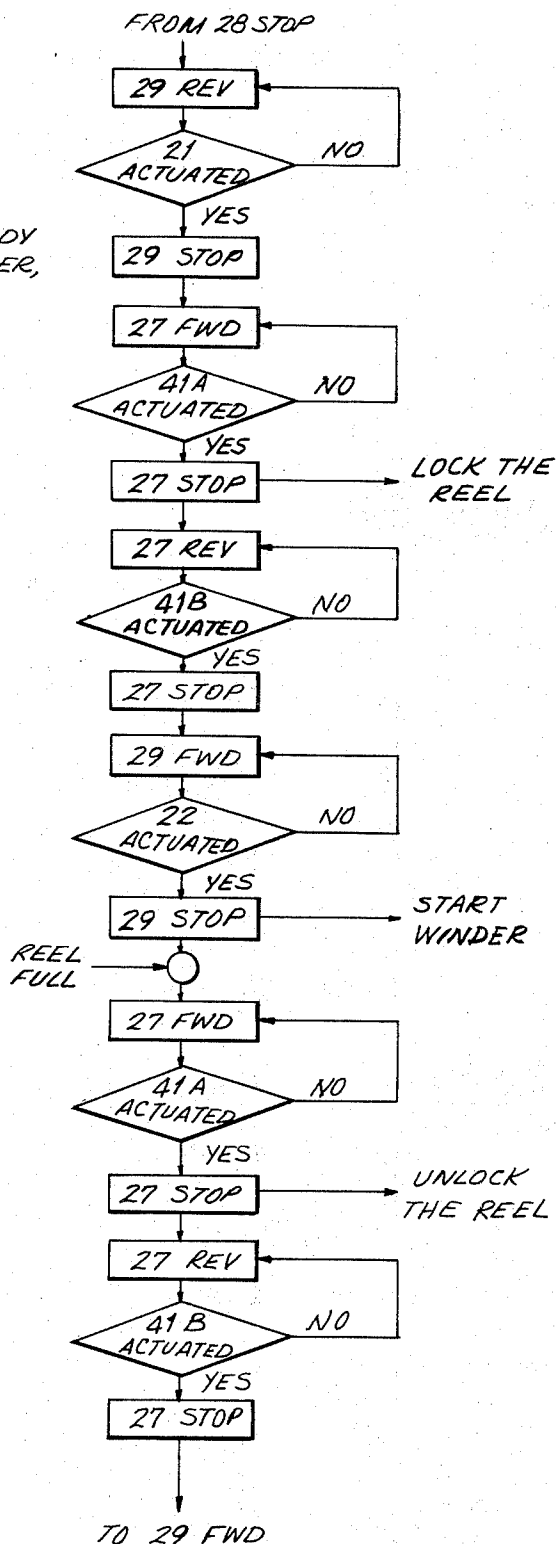
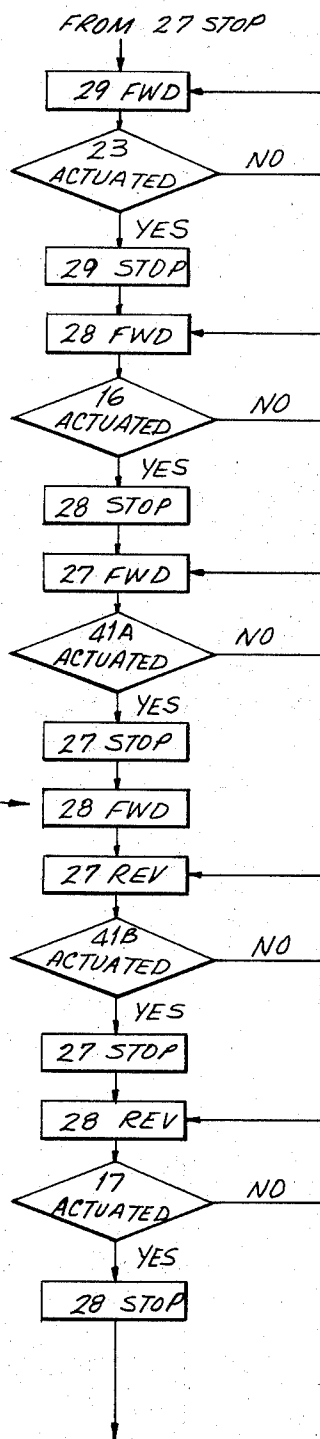


FIG. 10c

THE FULL REEL IS NOW IN
POSITION (23, 16)

THE REEL IS LET DOWN A FEW
CENTIMETERS SO THAT IT REMAINS
SUPPORTED BY THE SHELF

THE FULL REEL IS NOW IN THE
"BOOK SHELF" IN ITS RIGHT
PLACE AND THE CONVEYING
DEVICE STARTS CARRYING
NEW REEL TO THE WINDER.



THE PROCESS CONTINUES WITH THE SAME OPERATIONS,
THE PROGRAMMER ONLY SELECTS A NEW PLACE IN THE
SHELF BY THE AID OF THE MEMORY OF ITS INPUT LOGICS.

AUTOMATIC REEL EXCHANGING DEVICE FOR A WINDING APPARATUS

This application is a continuation-in-part application of Ser. No. 838,151, filed July 1, 1969, now abandoned; and of Ser. No. 159,636; filed July 6, 1971 now abandoned.

FIELD OF THE INVENTION

The invention relates to an automatic reel exchanging device for a winder intended for spooling threadlike or ribbonlike products. The device is particularly suitable for use in connection with doublewinders, but may also be used in connection with other types of machines handling threadlike or ribbonlike products.

DESCRIPTION OF PRIOR ART

In the manufacture of cables, and particularly in connection with wire drawing machines, different types of doublewinders have been used for a considerable period of time. Such devices are known, for example, from published German Pat. application No. 1,168,732 and from U.S. Pat. No. 2,546,636. When in winders of this type automation has been applied, generally this included the addition of a reel exchanging in which the mechanism removes the empty cable reel from a feeding channel or from a roller table attached to the machine, and transfers the full reel to a removing channel or the roller table. In these prior art devices the reels are moving so as to be either rolled or conveyed upon rolls toward the machine and from the machine. The operator has only to fill the feeding channel and to empty the removing channel. The empty reels are lifted into the feeding channel from a shelf-like transporting device, and the filled reels are lifted onto a similar device.

The prior art reel exchanging mechanisms are, however, subject to various disadvantages. Thus, when the filled reels are rolling in the removing channel, or are being conveyed along the roller table, the wound layers of the threads are unwound to a certain extent, in amounts increasing in proportion to the distance in which the reel is conveyed. In view of the foregoing, the capacity of the removing channel must be reduced to accommodate only a limited quantity of reels. Furthermore, since the reels have to be lifted onto the transporting device and then moved away therefrom, the operator of the winder must handle each reel twice.

SUMMARY OF THE INVENTION

The purpose of the present invention is to eliminate the disadvantage encountered in the prior art, by eliminating the unwinding of the reels, while concurrently decreasing the number of the operations of the winder operator.

The stated purpose of the invention is achieved with a reel exchanger of novel structure, whose main characteristics are as stated in the claims.

The advantages of the present invention lie in that the reels may be stored on novel shelf-like devices which will effectively prevent the reels from rolling or gliding so as to eliminate unwinding of the threads. Additionally, the shelf-like devices may be readily made in a size whereby the reel exchanger and the winder may be operated for a lengthy period of time without requiring action by the operator, and thereby greatly increasing the reeling capacity. In accordance with the inven-

tion, the shelf-like devices may simultaneously act as transporting elements, thereby eliminating two working operations for each reel. Furthermore, the design of the inventive winder is simplified, and is very convenient in use. Programming is readily applied to the reel conveyor, whereby, for example, the reels may be moved toward the shelf-like device, trucks, directly to storage, packing, stamping or inspection departments, belt conveyor, or to an adjoining machine.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention is now considered in the following description with reference to the accompanying drawing, wherein:

FIG. 1 shows the reel exchange device connected to a double-winder and a shelf-like reel holder;

FIG. 2 shows a section along line 2—2 of FIG. 1;

FIG. 3 shows a top view of the device shown in FIG. 1;

FIG. 4 illustrates a front elevational view, in an enlarged scale, of a portion of the reel exchange device;

FIG. 5 shows a side view of the device illustrated in FIG. 4;

FIG. 6 shows an enlarged partial view of the device illustrated in FIG. 3;

FIG. 7 shows a representative flow diagram for a programming unit utilized with the reel exchange device;

FIG. 8 illustrates a schematic block diagram of the internal functions of the programming unit and its interconnection with the reel exchange unit;

FIGS. 9a and 9b schematically illustrate representative movements of the reel corresponding to the operative directions of the actuating motors therefore; and

FIGS. 10a to 10c illustrate a schematic flow diagram of the operative sequence of the reel exchange device and the limit switches thereof as actuated by the programming unit.

DETAILED DESCRIPTION

In the drawings there are illustrated a winder 1 and a reel lifting and conveying device 2. In FIGS. 1 and 3 there are shown shelf-like reel holders 3 and 4 for the storing of empty and full reels. The reel conveyor 2 is adapted to be moved on rails 5 and 6 along the reel holders 3 and 4 and the winder 1. The winder 1 as shown herein is a double-winder provided with vertical axles. The reel conveying device 2 includes a reel transporting vehicle 7 provided with a forkshaped lifting element 7a. In FIGS. 2 and 3 the element 7a is depicted as carrying a reel 14A. The transporting vehicle 7 is moved vertically and horizontally by the conveying device 2. The movements of the transporting vehicle are governed by a programming device, through which the vehicle may be stopped at any designated height. In the horizontal direction of movement two stopping points for the transporting vehicle are generally sufficient in an arrangement as disclosed herein. If the reel holders 3 and 4 are designed to comprise two rows of reels, then three corresponding stopping points for the transporting vehicle would be required. The movements of the conveying device 2 along the rails 5 and 6 are governed by a programming device 39 connected to the reel exchanging apparatus, which facilitates the stopping of the conveying device 2 at any arbitrarily chosen point.

The reel exchanging apparatus is provided with the programming unit 39 which is operatively connected to three operating means electric motors 27, 28, 29 of the reel conveying device 2 and the reel supporting vehicle 7, respectively, to the winding machine 1 and to a localizing or positioning means. The localizing means may comprise a first horizontal row of spaced limit switches 21, 22, 23, 24, 25, 26 which localize or determine the horizontal position of the conveying device 2 along the rails 5 and 6, a second vertical row of spaced limit switches 16, 17, 18, 20 which determine the vertical position of the lifting fork 7a of the supporting means 7, and a third horizontal set of spaced limit switches 41 which determine the horizontal position of the lifting fork 7a.

The programming unit 39 may further include stepping relays which receive impulses from the limit switches. The stepping relays are coupled so as to actuate the electric motors 27, 28 and 29 in a selected sequence depending upon the operation of the winding machine and the impulses received from the limit switches, whereby the desired movements of the fork 7a are obtained. The selective sequence of the operation of the relays may be controlled by suitable punched cards or tapes inserted into the programming unit. The programming by means of stepping relays and limit switches is well known in the techniques of the programming art.

The programming unit 39 may be programmed in a manner well known in the art, such as by punched cards, punched tape, or the like. A typical programming unit which operates the limit switches 21, 22, 23, 24, 25 and 26 in the desired operative sequence is that manufactured by the Allen-Bradley Company, Milwaukee, WIS; designated PMC Programmable Matrix Controller, Bulletin 1750. The function of a typical programming unit of the type mentioned hereinabove is illustrated in greater detail in FIGS. 7 to 10 of the drawings.

The reel exchanging device functions as follows, having particular reference to FIGS. 4 to 6 of the drawings: The reel holders 3 and 4 are filled with empty reels. The conveying device 2 removes from the holder from position 8 an empty reel 8A, conveys it to the winder and positions it above a winder axle 9. The reel holding pin 10 in the winder is raised and locks the reel in working position, after which the transporting vehicle 7 moves to its rear position and the winding operation may start.

The reel conveying device 2 does not take part in the locking sequence of the reel in the winder. When the lifting fork 7a has transported an empty reel to the desired position with respect to the pin 10 of the winder a limit switch 41 sends an impulse to the locking mechanism of the pin 10 so as to lock the reel.

The position of the lifting fork 7a as shown in FIG. 2, is the rear position of the transporting vehicle, i.e., a position which allows the device 2 to be moved along the rails 5, 6. The forward position is the position of the lifting fork ready for lifting a reel from the reel holders 3.

During the winding the conveying device 2 conveys another empty reel 11A from the position 11, and positions it above another free winder axle 12, after which the conveying device 2 may be moved to its waiting position.

When both pins 10 of the winder have been provided with reels the lifting fork 7a is retracted to its rear position and the device 2 moves in front of the reel being spooled. This is the waiting position of the lifting fork. The fork remains in this position until the spooling of the reel has been completed and the spooling has been changed to the other spool. Then the pin 10 for the full reel stops and the motor 27 of the lifting fork receives an impulse from the programming unit to move the fork into its forward position where it receives the full reel. In this position the limit switch 41 then sends an impulse to the locking mechanism of the winder to release the full reel which is lowered down upon the lifting fork.

After the fork has received the reel, the programming unit starts the motor 27 for moving the fork to its rear position and thereafter the motor 29 for moving the device 2 along the rails 5, 6 until the motor is stopped upon contact with the limit switch 23, which corresponds to the horizontal delivery position of the reel in the storage. Thereafter the programming unit starts the motor 28 for moving the fork downwards until it is stopped upon contacting the limit switch 16. The motor 27 is then actuated so that the fork moves the full reel 8A into the corresponding space of the reel holder 3.

Finally the fork takes the following empty reel 14A from the position 14 which is positioned above the full reel 8A, and brings it to the position as shown in FIG. 3.

The horizontal movement of the fork 7a is obtained by the motor 27, which actuates tooth wheels 30 by means of a shaft 40. The wheels 30 are in engagement with tooth racks 33 fixed to the fork. The fork is supported by wheels 34.

The reel conveying device 2 is supported by wheels 35 on the rail 6. The motor 29 actuates a chain wheel 38, which in cooperation with chain wheels 37, is in engagement with a longitudinal chain in the rail 5. The stopping positions of the horizontal movement are defined by the limit switches 21, 22, 23, 24, 25 and 26 which are fastened to the rail 5.

In other words, when the winding of the reel 8A on the axle 9 is completed and the winding is transferred to the reel 11A on the axle 12, the movement of the winding axle 9 is stopped, whereupon the conveying device 2 once again commences in removing the reel from the winder axle 9 and returns it to the position 8. After this the conveying device 2 takes a reel 14A from the position 14, and conveys it to the winder axle 9.

When the device 2 has moved to the limit switch 23, i.e., in front of the first vertical row of the reel holder together with the full reel 8A, the limit switch 16 defines the vertical delivery position of the fork. The fork moves to its forward position, whereupon the programming unit sends the motor 28 an impulse to move a little distance further downwardly so that the reel is then supported by the reel holder.

In a corresponding manner, when the fork is conveying in an empty reel, the programming unit sends the motor 28 an impulse to move upwardly a further little distance, so that the empty reel is then supported by the fork.

When the winding operation of the reel 11A on winder axle 12 is again completed, and the winding is transferred to the reel 14A positioned on the winder axle 9, the conveying device 2 removes the reel 11A from the winder axle 12 and returns it to the position

11, after which it takes a reel 15A from position 15. The operative movements proceed in a corresponding sequence until all of the reels in the holder 3 have been fully wound. Subsequently, the reel exchanging device moves over so as to remove full reels from the holder 4, and the holder 3 is exchanged for another holder containing empty reels.

The programming unit 39 for the reel exchanger may be designed in many different ways, on the basis of known technical methods. For example, the limit switches 21, 22, 23, 24, 25 and 26 may be attached to the rail 5 opposite each row of reels in the holders 3 and 4, and also opposite the axles 9 and 12 of the winder. The conveying device 2 itself may have limit switches attached thereto at various planes extending through the height of the reels, and also at the elevation of the reels on the winder 1. Similarly, limit switches may be attached to the gliding rails for the transporting vehicle 7 so as to govern the stopping of the vehicle in either the forward or the rear position thereof. Through logistic elements contained in the programming device, functioning or operational orders may be transmitted to the motor of the reel conveying device 2 and to the appropriate limit switches.

Reverting now in greater particularity to the function of programming unit 39, having reference to FIG. 7 of the drawings, this shows the electrical interconnections between the programming unit and various switches on the actuator motors for the reel exchange device. Shown schematically, and as identified in the drawing, are the electrical connections with reference to the various reel horizontal positioning switches 21-26, lifting fork vertical positioning switches 16-20, and lifting fork positioning switches 41a, 41b, and the motors 27, 28 and 29.

FIG. 8 of the drawings shows the block diagram of the major components of the programming unit 39 for effecting its internal functions. The particular components are each commercially produced elements forming part of the Allen-Bradley PMC Programmable Matrix Controller.

A more detailed description of the sequence of operation of the programming unit 39 is given with respect to FIGS. 9a, 9b and 10 of the drawings.

Thus, the reel conveying device 2 is assumed to have conveyed the last full reel into a "book shelf" and is waiting for a new "book shelf." The term "book shelf" signifies the shelf-like reel holder 3, 4.

As shown in FIGS. 9a and 9b, the directions of movement of the reel is correlated with directions of operations of the actuator motors (according to FIG. 7 of the drawings).

FIGS. 10a to 10c illustrate a typical programming sequence which may be described with reference to, for example, the following operative cycle:

Considering, for example, a situation in which the right reel has been filled and stopped. This imparts to the system a signal for reel change. In this case, the conveying device 2 is initially located at the right reel and the lifting fork is in. Limit switches 22 and 41b are thus actuated. At reel change, signal motor 27 starts and pushes the lifting fork out until switch 41a is actuated, indicating that the lifting fork has travelled the full distance. Motor 27 is then reversed and the reel is pulled out by means of the lifting fork. When the fork is completely in, switch 41b gives permission for motor 29 to start moving the conveying device to the right.

When the system reaches the horizontal position, where whence it originally brought the empty reel, it actuates the appropriate limit switch (for example, 24) and stops motor 29. Switch 16 is simultaneously actuated. If the reel was originally brought from position 24, 17, motor 28 now starts and runs until switch 17 is actuated. This provides permission for the motor 27 to start pushing out the lifting fork. The operation continues in a similar manner as previously indicated.

The above can be expressed by Boolean equations basically as follows:

In short, the reel change signal is denoted by R.

A	$27 \text{ FWD} = 22 \times 41b \times R + R \times 41a$
B	$27 \text{ REV} = R \times 41a + R \times 41b$
C	$29 \text{ FWD} = R \times 41b \times A \times B + R \times A \times B \times 24 \text{ (2)}$
D	$28 \text{ FWD} = R \times C + R \times 17 \text{ (2)}$
E	$27 \text{ FWD} = R \times D + R \times 41a$

In this instance, "(2)" after the limit switch numbers indicates that this position is being used for the second time. The first time was when the conveying device brought out the empty reel. This has been set in the memory of the programming unit exactly in the same manner as positions A and B were used as conditions for position C. The programmer thus remembers that when the lifting fork has been in a shelf zero times, there is an empty reel once, the shelf is empty twice, there is a full reel

The system is programmed so that the fork never goes to a shelf for a third time, but will skip it.

The above mentioned Boolean equations are translated into the language used by the Allen-Bradley Controller, and entered through the special unit

A	XIO 22 XIO 41b XOE R BRT XOE R XIC 41a SET 27 FWD
B	XOE R XIO 41a BRT XOE R XIC 41B SET 27 REV
C	XOE R XIO 41b XOE A XOE B BRT XOE R XOE A XOE B XIO 24 (2) SET 29 FWD
D	XOE R XOE C BRT XOE R XIC 17 (2) SET 18 FWD
E	XOE R XOE D BRT XOE R

After the program, covering all the functions required, has been entered and the connections shown in FIG. 7 have been made, the equipment is ready to be used.

Furthermore, it is also possible to control the operation of the reel exchange by means of known numerical operating sequences, where the position is determined by coordinates which are counted commencing from a known starting point. The coordinate reports may be readily obtained by means of impulse senders which are coupled to the conveyor motors, whereby the impulses generated in dependence upon the direction of the movement either increase or decrease the coordinate number provided by the computers.

The programming may also be accomplished by means of perforated ribbons, tapes or cards.

The reel exchanging device may, through suitable programming, be adapted to move the reels, besides to the reel holders, also onto trucks, into casings, or to an adjacent machine. The operative range of the reel exchanger may be therefore, depending on prevailing conditions, made very extensive or restricted as desired.

Although there has been shown and described an embodiment in which the winder is provided with vertical axles, it becomes readily apparent to one skilled in the art that the reel exchanging device may also be used in connection with winders having horizontally arranged axles.

The drawings and the description are only intended to be illustrative of the invention, and modifications and other embodiments may be contemplated within the scope of the following claims.

What is claimed is:

1. An automatic reel changing apparatus for a winding machine for spooling threadlike products, comprising a reel conveying device, operative means for moving said device in a horizontal direction, said device including reel supporting means, first operative means for moving said reel supporting means in a vertical direction and separate operative means for moving said reel supporting means in a horizontal direction perpendicular to the horizontal direction of movement of the device, means for localizing the position of said reel supporting means in said vertical and horizontal directions, and a programming unit being operatively connected to each of said operative means, localizing means and the winding machine, said programming unit including means for actuating each of said operative means in dependence of the winding operation of the winding machine and the positions of stationary reels in a storage so as to cause the conveying device and the supporting means to grip an empty stationary reel from said storage, to transfer said empty reel to the winding machine substantially in winding position, to receive the reel from the winding machine after completed winding, to transfer said completed reel to said storage in a stationary position and to repeat said reel transferring operations with a next reel located in said storage in a different position with respect to the preceding transferred reel.

2. An apparatus as claimed in claim 1, wherein said programming unit is programmed by means of a punched card.

3. An apparatus as claimed in claim 1, wherein said programming unit is programmed by means of punched tape.

4. An apparatus as claimed in claim 1, wherein said localizing means comprise limit switches.

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