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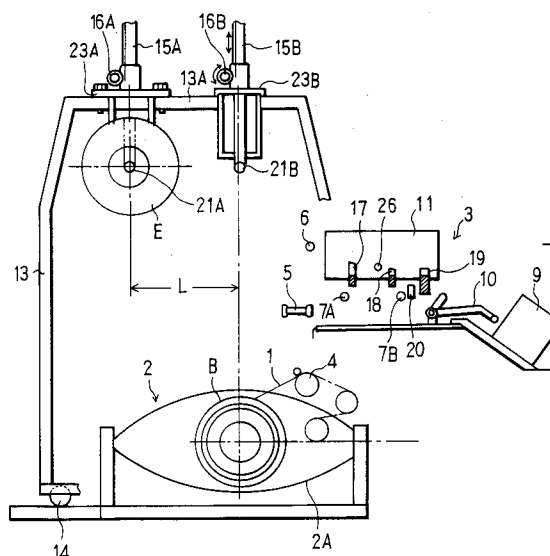
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London WC2A 3LS (GB)**(54) **Method and apparatus for automatic exchange of bobbins.**

(57) Object: To provide a method and an apparatus for automatic exchange of bobbins of a twisting or assembling machine.

Construction: The empty bobbin (E) is kept in waiting near the winding (twisting or assembling) machine (2), the empty bobbin (E) and the full bobbin (B) are supported always with a predetermined horizontal distance (L) between them during the exchange process, and the full bobbin (B) is unmounted from the winding machine (2) and moved to the exchange work table (3), keeping the cable (1) always in stretched condition through out the exchange process. The stretched cable (1) is urged toward the inside surface of the flange of the empty bobbin (E) which is moved to follow the full bobbin (B) with the constant horizontal distance (L) therebetween, and, after the cable (1) is cut, one end thereof is fixed to the outer periphery of the full bobbin (B), while the other end is hooked and drawn outside the flange of the empty bobbin (E) for various characteristics tests.

FIG.1



This invention relates to a method and an apparatus for automatic bobbin exchange in a cable-winding machine.

In this specification the term "cable" includes an electric cable having one, two, three or more wires, whether twisted or not, and also includes a rope, strand, wire, ribbon, tape or cord, whether of metal or of natural or synthetic fibres, and whether multi-filamentary or mono-filamentary, and the term is to be broadly construed accordingly.

There have been several previous proposals with regard to automatic bobbin exchange in a cable-winding machine.

In the previous proposals for electric cable-winding machines, however, emphasis has been put on smooth transfer of the cut end of the cable from a full bobbin to an empty bobbin as a starting end for winding, and no attention has been paid to the fact that the starting end is soon buried under the bottom layer of wound cable, which results in a serious inconvenience in quality control such that it is impossible to make electrical continuity tests of the electric cable taken-up on the bobbin or to measure values of electrostatic coupling thereof.

Furthermore, there has been a drawback in the previous proposals that, since there is no relationship between the positions wherein a full bobbin and an empty bobbin are held, the apparatus tends to be complex and expensive.

SUMMARY OF THE INVENTION

The object of the invention is to solve the problems of the prior art stated above.

According to a first aspect of the invention, there is provided a method for automatic exchange of bobbins on which a cable is being, or is to be, wound, the method comprising the following steps:

providing an empty second bobbin in a waiting or standby condition near a winding machine whereat the cable is being wound onto a first bobbin;

removing the first bobbin when full from the winding machine and transferring said full bobbin to a changeover station or an exchange work table;

keeping the cable in stretched condition during said transfer process;

bringing the cable toward the inner surface of one of a pair of flanges of said empty bobbin that is moved to follow said full bobbin;

cutting the cable and fixing one end thereof to the outer periphery of said full bobbin;

hooking the cable and drawing out said cable to the outside of one of the flanges of said empty bobbin; and

moving said empty bobbin downward as it is rotated so as to wind the cable thereon and then mounting said empty bobbin on said winding ma-

chine;

characterized in that, during the exchange process, said empty bobbin and said full bobbin are supported in such a manner as to have always a pre-determined horizontal distance therebetween.

According to a second aspect of the invention, there is provided an apparatus for automatic exchange of bobbins by the method according to said first aspect of the invention comprising;

a changeover station or exchange work table whereat one cut end of the cable is attached to said empty bobbin as a starting end for winding;

a biasing roll for shifting the position of said cable, to move the cable close to the inside of one flange of the empty bobbin;

under-rollers to rotate said empty bobbin;

a bobbin-fixing block to press fix said empty bobbin to a predetermined position on said work table;

a plurality of cable-holding plates that force said cable toward the inner surface of the flange of said empty bobbin and a cutter to cut said cable;

devices to fix the end of said cable wound on said full bobbin; and

a plurality of sensors that detect positions of drawn-out end of said cable, said empty bobbin and said full bobbin;

characterized in that said automatic bobbin exchange apparatus is provided with a bobbin carrier that holds and carries said full bobbin and said empty bobbin in such a manner that the horizontal distance therebetween is kept to a predetermined value, and a hooking rod that draws said cable out of the inside of one of the flanges of said empty bobbin.

The invention will be described by way of example with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a general side elevational view of an embodiment of the invention;

Fig. 2 is a side elevational view similar to Fig. 1 and illustrates the bobbin exchange operation;

Figs. 3(a), 3(b) and 3(c), referred to collectively as "Fig. 3", are side elevational views illustrating the method of drawing the starting end for winding out of the inside of the flanges; and

Figs. 4(a) and 4(b) illustrate axial shifting of a full bobbin in order to position the cable correctly relative to the empty bobbin.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The illustrated apparatus comprises a winding station 2, where cable is wound onto a bobbin such as bobbin B. The winding station 2 is actually an

electric cable-assembling station for producing pair-twisted cables or quad-twisted electric cables such for example as are used for telephone installations.

The apparatus also comprises a changeover station 3, or "exchange work table", where the cable being wound onto successive bobbins is changed over from each fully-wound bobbin to the next, empty, bobbin to be wound.

Together with the apparatus there are shown two bobbins, namely, a full (or nearly full) bobbin B and an empty bobbin E. The two bobbins are shown with parallel, horizontal axes (normal to the plane of the drawing in each of Figs. 1 and 2) spaced apart by a predetermined distance L (see below).

The illustrated apparatus comprises a bobbin carrier 13 which is mounted on wheels 14 that run on guide rails (not shown) for the bobbin carrier 13 to be moved reciprocatingly (leftwards and rightwards in Fig. 1) by drive means (not shown) between the winding station 2 on the one hand and the changeover station 3 on the other hand. An overhead portion 13A of bobbin carrier 13 carries two vertical elongate lifting members, in the form of toothed racks, 15A and 15B which are horizontally spaced from each other by the predetermined distance L (like bobbins B and E) in the direction of reciprocation of bobbin carrier 13.

The rack 15A extends vertically through a guide 23A which is bolted to the overhead portion 13A of bobbin carrier 13, so that rack 15A can move up and down, but in no other direction, relative to the bobbin carrier 13. The rack 15A is engaged by a toothed pinion 16A, driven by means not shown, for controlling the up and down displacement of rack 15A relative to bobbin carrier 13.

The rack 15B extends vertically through a guide, which is in the form of a slide frame 23B and which extends in a horizontal direction normal (that is, perpendicular) to the plane of Fig. 1. The slide frame 23B can be moved reciprocatingly, by drive means not shown, in the horizontal direction normal to the plane of Fig. 1, relative to the bobbin carrier 13. To this end, a part (not shown) of slide frame 23B forms a toothed rack which is engaged by a driven toothed pinion (not shown) for controlling its displacement, normal to the plane of Fig. 1, relative to the bobbin carrier 13. The slide frame 23B carries a toothed pinion 16B which drivingly engages toothed rack 15B for controlling the up and down displacement of rack 15B relative to the slide frame 23B. Hence, relative to bobbin carrier 13, the rack 15B can move up and down and can also be moved in a direction normal to the plane of Fig. 1.

The movements of said lift racks 15A, 15B and of slide frame 23B are each effected here by a

combination of rack and pinion, but it should be understood that the linear motion described in the invention can be effected by any other driving means such as wheels running on guide rails, a feeding screw axle, a hydraulic cylinder, an electromagnetic solenoid, etcetera.

Either lift rack 15A and 15B can move up and down independently of the other, relative to bobbin carrier 13. The lower end of each lift rack 15A, 15B carries a horizontal pintle 21A, 21B respectively, each projecting normal to the plane of FIG 1 and each rotatable about its own axis by a respective torque motor (not shown) which can also brake the pintle 21 against undesired rotation. Each pintle 21A, 21B is adapted to carry a bobbin, such as bobbin B or bobbin E shown in the drawings, with the axis of the bobbin extending normal to the plane of Fig. 1, when a free end of the pintle 21 is poked through an axial hole in the bobbin. The left-hand pintle 21A, for the empty bobbin, such as bobbin E, is adapted to be rotatably driven in a counter-clockwise direction for winding cable initially for a few turns onto the bobbin.

At the changeover station 3, which takes the form of a so-called "exchange work table", under-rollers 7A, 7B, rotatably drivable by means of a motor, not shown, are provided at the position where the empty bobbin, such as bobbin E, is set down by lift rack 15A. Numerals 17, 18 designate cable-holding plates, made of rubber or soft plastics, each actuated by a suitable hydraulic cylinder to force the cable 1 toward the inner surface of a flange of the empty bobbin E.

Also at the changeover station 3, a biasing roll 5 extends, at a suitable position on the left of the set-down position of the empty bobbin E, parallel to the plane of the drawing, and above this biasing roll 5 is arranged a cable-drawing roller 6 for drawing out the cable 1. Numeral 9 designates a delivery device for delivery of adhesive tape, and numeral 10 designates a press lever for press-glueing one end of the adhesive tape, paid out by said delivery device 9, to the outer periphery of the full bobbin E.

As shown in Fig. 2, on the right of cable-holding plates 17, 18 there is also provided a cable-holding plate 19 that holds and fixes the cable 1, and a cutter 20 is provided between said cable-holding plates 18 and 19 to cut the cable. The cable-holding plates 17, 18 and 19, as well as the cutter 20 are, as shown in Fig. 3, actuated by suitable hydraulic cylinders to be forced against the inner surface of the flange of the empty bobbin E or to be retracted therefrom.

The fixing of the empty bobbin E is effected by a bobbin-fixing block 11 that presses the side surfaces of the flanges, and a hooking rod 12 that reciprocates through one of the flanges plays the

role to draw out the cable from inside of the flanges of the empty bobbin E.

The block 11 is in touch with one of the flanges of the empty bobbin E and is subject to forces from the cable-holding plates 17, 18. It further supports a photo-coupler, see below, but nothing more. The empty bobbin E itself is stable on the under rolls 7A, 7B only under influence of gravity. The block that is seen in Fig. 3 on the side of the other flange is nothing more than a cover.

Now, the steps of the method according to the invention will be described in order. In the description, position sensors (mainly photoelectric sensors or limit switches) that are not mentioned above will be described as occasion arises.

Position-sensing by means of photo-electric sensors is well-known. It may involve, for example, detecting the position of an object by means of a pair of parallel light beams generated by photo-couplers (each of which consists of a light-emitting element and a receiving element combined together and available as a combined unit on the market. For example, use may be made of a pair of light beams generated from two pairs of photo-couplers attached on the block 11 and on the opposite side of the cover.

As the bobbin B mounted on the twisting or assembling machine 2 nears full condition, the bobbin carrier 13 moves to bring the empty bobbin E to a waiting position thereof shown in Fig. 1. As the bobbin B fills up and the rotation of the twisting or assembling machine 2 stops, and as the safety cover (not shown) is opened, then the lift rack 15B moves downward and the pintle 21B moves upward holding the full bobbin B and then moves to the right, as indicated in Fig. 2 by an arrow. In the case of the twisting machine shown here which has an arched flyer 2A, the machine is controlled in such a manner as to stop when the open side of the flyer faces upward.

If only the movements of the bobbins are to be described, the full bobbin B and the empty bobbin E that follows it with a horizontal distance L therebetween then move right to the predetermined end position shown in Fig. 2, then move downward and, after the position of the full bobbin B has been adjusted, as will be described just below, by a certain displacement in the direction perpendicular to the plane of Fig. 2, the two bobbins B and E are set down on the exchange work table 3. The positions of the set-down bobbins are of course controlled in accordance with the detected results of photoelectric sensors (not shown) arranged at suitable positions.

The empty bobbin E is adjusted as to the angular position thereof by the under-rolls 7A, 7B until a pair of marker holes 8 are detected by the photoelectric sensors, and a cable hole 22 pro-

vided at an angular distance from said marker holes 8 is brought to the predetermined position shown in Fig. 2. The empty bobbin E is then pressed against and hence fixed by the bobbin-fixing block 11 that acts on the side surface of the flange as shown in Fig. 3 (if explained with reference to Fig. 2, on the rear side of the sheet). After this, both of the lift racks 15A, 15B are retracted upward.

The movement of the cable 1 accompanying the above described movement of the empty bobbin E is as follows: The cable 1 first turns upward at the traverse roller 4 and then engages with the cable-drawing roller 6. As the cable 1 moves in the direction indicated by the arrow in Fig. 2 and reaches the biasing roll 5, the cable at this position is detected by the photoelectric sensor 24 (composed of a light emitter and a light receiver) mounted in such a manner as to emit light in the direction perpendicular to the plane of the drawing, and the biasing roll 5 moves in the direction perpendicular to the plane of the drawing away from the eyes and thereby forces the cable 1 in the same direction, that is, rearwardly of the sheet. Further, the deflection of the cable 1 (which takes place in the plane perpendicular to the drawing sheet) is detected by another photoelectric sensor 25, and the slide base 23 that starts to move according to the detected signal forces the full bobbin E in the direction away from the eyes and toward the setting position described in the previous section (see Figs. 4(a) and 4(b)).

In this manner, the cable 1 is urged, as shown in Fig. 3 (a), toward the inside of the flanges of the empty bobbin E that follows the full bobbin B with the constant horizontal distance L. It should be noted here that, since the rotation of the pintle 21B that holds the full bobbin B while it is moved, is under braking action, the cable is given a suitable tension and is kept in stretched condition.

Next, the cable-drawing roller 6 moves upward and thereby draws out a needed length of the cable 1. This length is the stretch of the cable 1 necessary as the starting end for winding which is drawn out of the inside of the flanges of the empty bobbin E through the cable hole 22. After this, the cable-holding plates 17, 18 are actuated and force the cable 1 against the inner surface of the flange and fix it there. The cable-holding plate 19 press fixes the cable 1 at the position just off the flange. Then the cutter 20 is actuated and cuts the cable 1.

[The cable is always in stretched condition during the process of dismounting the full bobbin B from the twisting machine 2 and moving it to the changeover station 3, because, as explained herein, the cable is drawn out forcibly from the bobbin B as the bobbin B is moved under braking action -

here, of course the bobbin is rotated by the cable tension in the direction to pay out the cable.]

Next, as shown in Fig. 3 (a), the hooking rod 12 protrudes, if seen in Fig. 2, from behind the sheet toward the eyes by way of the through hole 26 and hooks the cable 1 as shown in Fig. 3 (b). Then, the cable-holding plates 17, 18 are released and the cable 1 is drawn out for the needed length.

The hole 26 is not shown in all the Figs. Of course, it would appear both in Fig. 1 and 2 if it were not omitted. In Fig. 2 it is in an overlapped position with the hole 22 of the bobbin.

The handling of the end of the cable 1 at the full bobbin B is as follows:- to the cut end end of the cable 1 wound on the full bobbin B is applied a piece of adhesive tape, delivered from the tape delivery device 9, by the press lever 10, and the cable end is attached to the outer periphery of the layer of the wound cable 1 by the action of the counter-clockwise rotation given to the full bobbin B through the pintle 21B. The full bobbin B which is given the disposal of the cable end is then transferred to an appropriate storage. It should be understood here that the fixing of the cable end may be effected not only by use of adhesive tape as described here but also by knotting or twisting the cable end.

The empty bobbin E that is finished with drawing-out of the starting end of the cable 1 outside the flange is held rotatably by the pintle 21A of the lift rack 15A and, being derived by the same for counter-clockwise rotation, that is, taking up the cable 1 about the barrel thereof, is carried toward the twisting or assembling machine 2 and mounted thereon. In the process, the starting end for winding is held by a clamp plate (not shown) belonging to the pintle 21A; hence there is no need to fear that the cable end may come off the cable hole 22 of the full bobbin E. After the empty bobbin E is mounted on the twisting or assembling machine 2, the lift rack 15A moves to the position to hold the next empty bobbin and wait.

In accordance with the invention, the strand or collected-cable is pressed in stretched condition to the inner surface of the flange of the empty bobbin, hence the effect that the cable is easily hooked from outside by the hooking rod. Further, since the empty bobbin and the full bobbin are supported always with a predetermined horizontal distance between them, there is the advantage that both bobbins can be carried easily by the bobbin carrier. The fact that the starting end of the cable for winding is drawn outside the flange for a necessary length makes it easy to carry out continuity tests of the cable or the like and hence is very effective for quality control of the cable.

Claims

1. A method for automatic exchange of bobbins (B, E) on which a cable (1) is being, or is to be, wound, the method comprising the following steps:
 - providing an empty second bobbin (E) in a waiting or standby condition near a winding machine (2) whereat the cable (1) is being wound onto a first bobbin (B);
 - removing the first bobbin (B) when full from the winding machine (2) and transferring said full bobbin (B) to a changeover station or an exchange work table (3);
 - keeping the cable (1) in stretched condition during said transfer process;
 - bringing the cable (1) toward the inner surface of one of a pair of flanges of said empty bobbin (E) that is moved to follow said full bobbin (B);
 - cutting the cable (1) and fixing one end thereof to the outer periphery of said full bobbin (B);
 - hooking the cable (1) and drawing out said cable (1) to the outside of one of the flanges of said empty bobbin (E); and
 - moving said empty bobbin (E) downward as it is rotated so as to wind the cable (1) thereon and then mounting said empty bobbin (E) on said winding machine (2);
 - characterized in that, during the exchange process, said empty bobbin (E) and said full bobbin (B) are supported in such a manner as to have always a predetermined horizontal distance (L) therebetween.
2. An apparatus for automatic exchange of bobbins by the method of claim 1 comprising:
 - a changeover station or exchange work table (3) whereat one cut end of the cable (1) is attached to said empty bobbin (E) as a starting end for winding;
 - a biasing roll (5) for shifting the position of said cable (1), to move the cable (1) close to the inside of one flange of the empty bobbin (E);
 - under-rollers (7A,7B) to rotate said empty bobbin (E);
 - a bobbin-fixing block (11) to press fix said empty bobbin (E) to a predetermined position on said work table (3);
 - a plurality of cable-holding plates (17,18,19) that force said cable (1) toward the inner surface of the flange of said empty bobbin (E) and a cutter (20) to cut said cable (1);
 - devices (9,10) to fix the end of said cable (1) wound on said full bobbin (B); and
 - a plurality of sensors that detect positions

of drawn-out end of said cable (1), said empty bobbin (E) and said full bobbin (B);

characterized in that said automatic bobbin exchange apparatus is provided with a bobbin carrier (13) that holds and carries said full bobbin (B) and said empty bobbin (E) in such a manner that the horizontal distance (L) therebetween is kept to a predetermined value, and a hooking rod (12) that draws said cable (1) out of the inside of one of the flanges of said empty bobbin (E).

3. An apparatus as claimed in Claim 2, wherein the bobbin carrier has two lifting members (15A, 15B) which can be raised and lowered independently of each other for lifting and lowering said bobbins (B, E) and which are spaced mutually apart by said predetermined horizontal distance (L).
4. An apparatus as claimed in Claim 3, wherein a predetermined one (15A) of the two lifting members is for lifting and lowering only bobbins which are empty or substantially or effectively empty, whereas the other one (15B) of the two lifting members is for lifting and lowering only bobbins which are full or substantially or effectively full.
5. An apparatus as claimed in Claim 3 or 4, wherein each lifting member (15A, 15B) has a pintle (21A, 21B) engageable in a hole in the bobbin (B, E).
6. An apparatus as claimed in Claim 5, wherein each pintle (21A, 21B) is drivable by a torque motor for braking and/or winding purposes.
7. An apparatus as claimed in any one of Claims 3 to 6, wherein each lifting member (15A, 15B) is raised and lowered by means of a rack and pinion (16) mechanism.
8. An apparatus as claimed in any one of Claims 3 to 7, wherein one said lifting member (15B) is movable relative to the other (15A) for repositioning the cable (1) relative to one of the bobbins (E).

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FIG.1

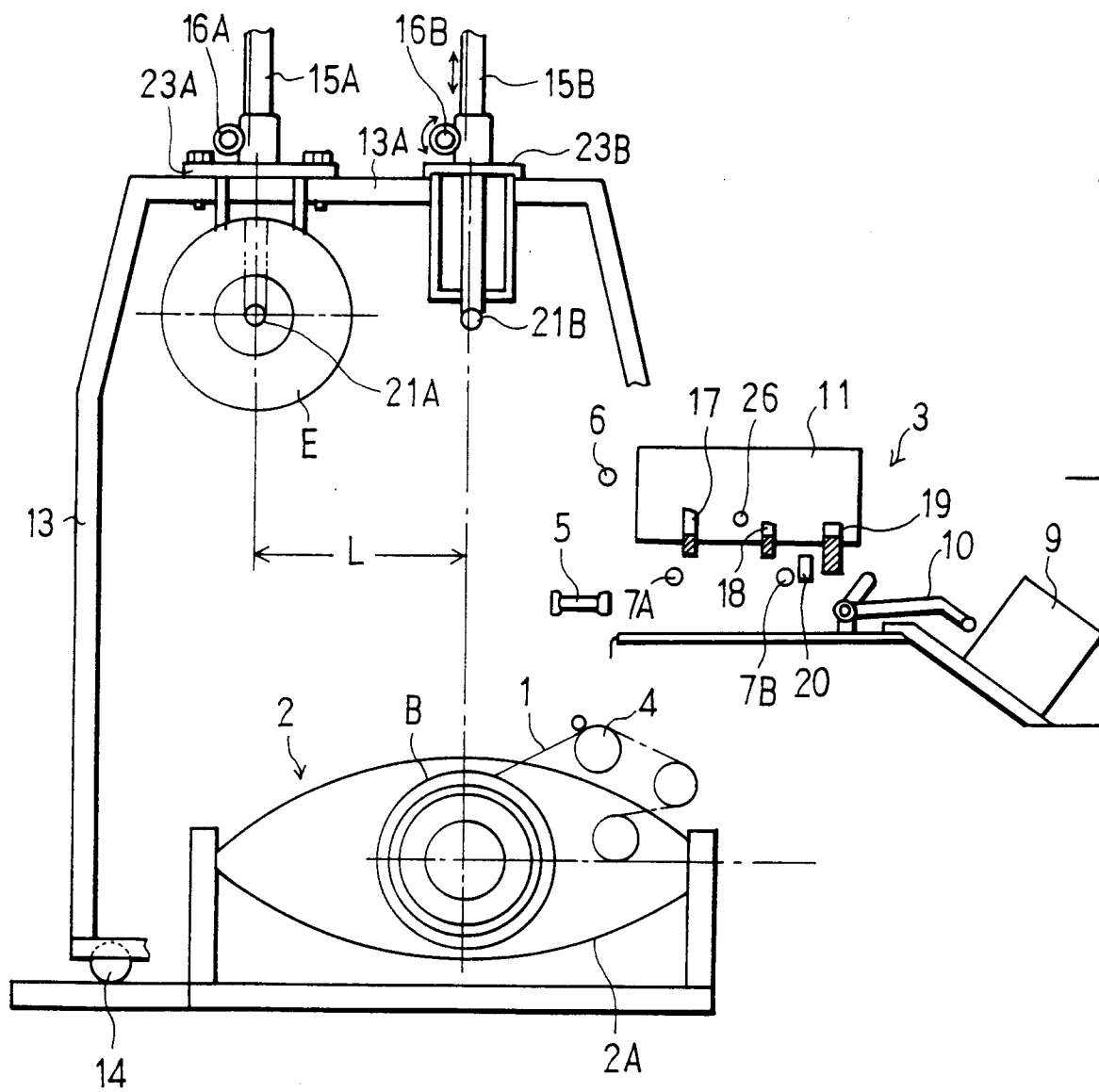


FIG.2

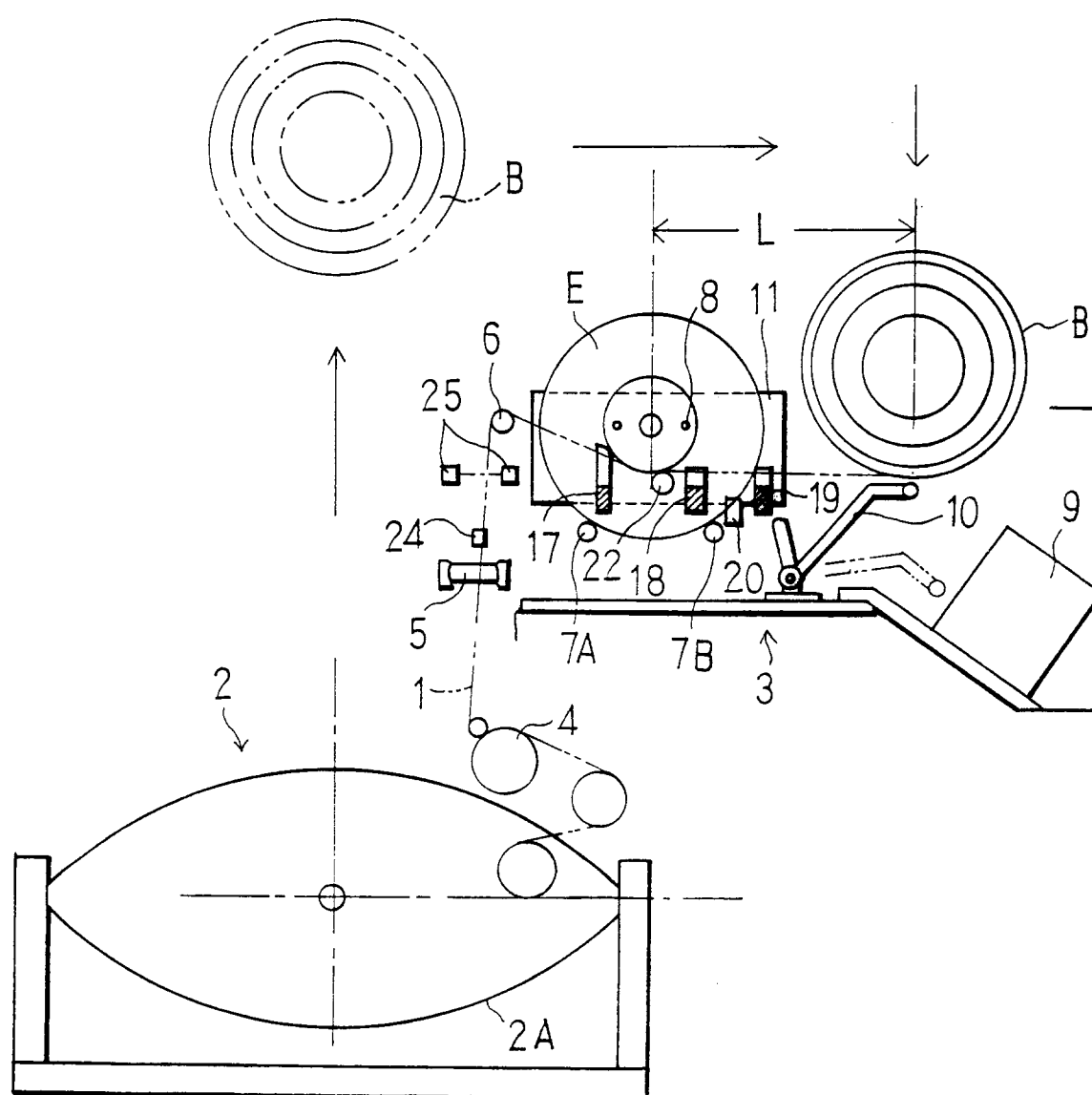
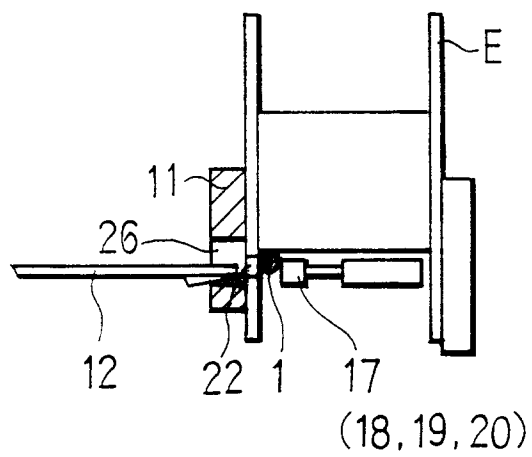
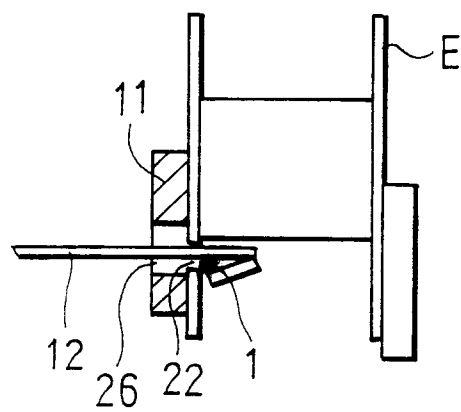


FIG. 3

(a)



(b)



(c)

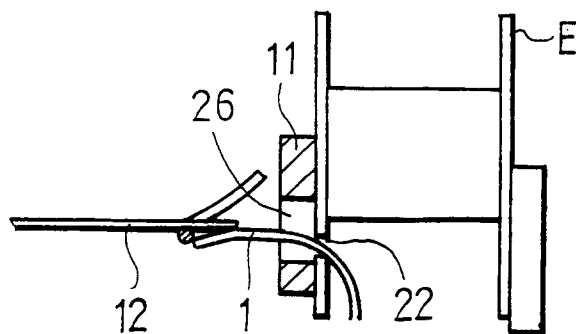
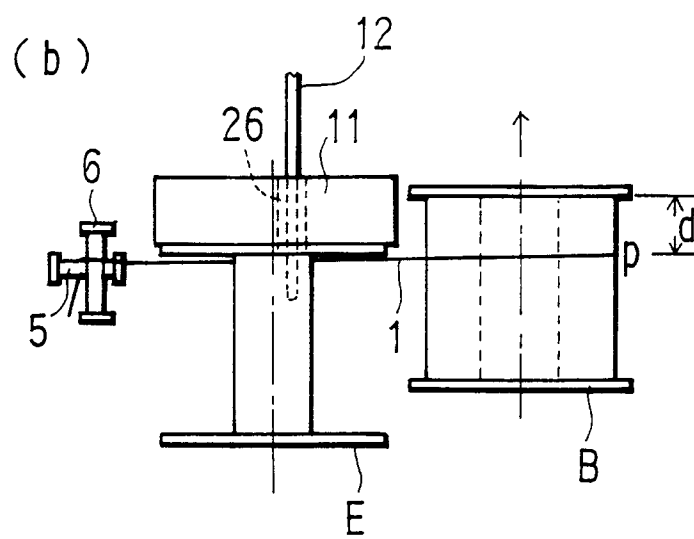
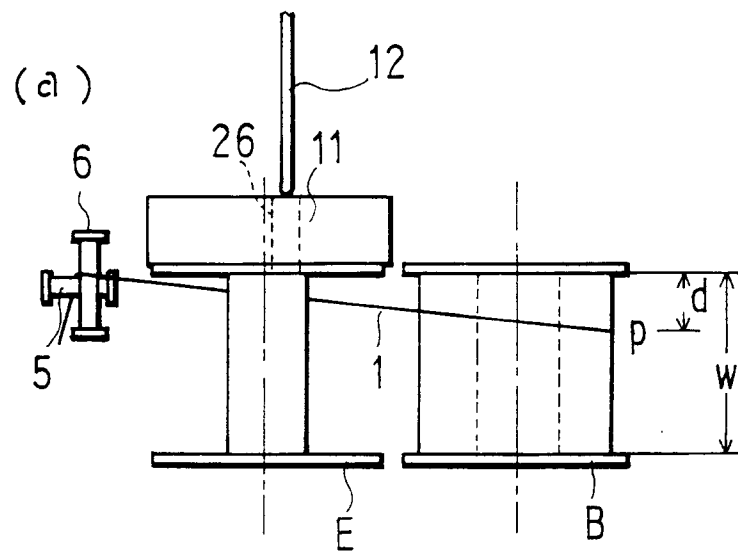


FIG.4





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 9174

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	GB-A-2 169 626 (MASCHINENFABRIK NIEHOFF KG) * page 2, line 33 - page 3, line 80 * ---	1,2	D07B7/16 B65H67/04 B65H65/00
A	EP-A-0 209 093 (S.A.M.P. S.P.A. MECCANICA DI PRECISIONE) * column 6, line 37 - column 8, line 34 * ---	1,2	
A	EP-A-0 267 157 (MAILLEFER S.A.) * column 2, line 28 - column 3, line 23 * * column 4, line 53 - column 5, line 58 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			D07B B65H H01B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 June 1994	Examiner Goodall, C
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