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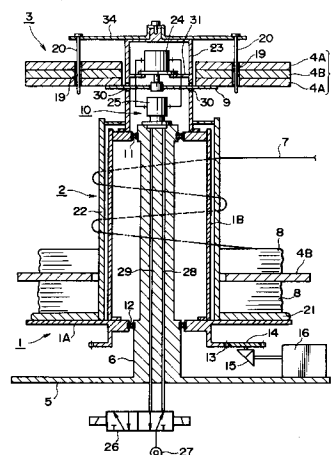
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D-81925 München (DE)**(54) **Wire winding apparatus.**

(57) A wire winding apparatus is disclosed which can continuously wound up a wire into a plurality of bundles readily and with certainty without interrupting operation of the apparatus and can achieve labour saving, improvement in productivity and improvement in quality at a reduced cost. The wire winding apparatus is so constructed as to wind a wire (7) having a rigidity into a plurality of coils each in the form of a bundle interposing a spacer each time a coil unit constituted from a predetermined amount of the wire is taken up. The wire winding apparatus includes a turntable (1) mounted for rotation around a vertical axis, a take-up frame (2) carried coaxially for integral rotation on the turntable (1) and having a winding portion (22) around which the wire delivered thereto is wrapped, and a spacer supply apparatus (3) provided coaxially above the turntable for supporting thereon a plurality of spacers (4) each in the form of a perforated plate in such a manner as to allow, each time a coil unit is taken up onto the take-up frame (2), a spacer (4) to drop therefrom so that the spacer may be loosely fitted

onto the winding portion (22) of the take-up frame thereby to interpose the spacer between two adjacent coil units.

FIG. 1

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a wire winding apparatus which can wind up a wire such as a steel wire as a material for production of a spring in units of a coil of a predetermined amount having a predetermined profile and can successively form a plurality of coils each in the form of a bundle.

2. Description of the Related Art

Among various metal wires, spring wires or stainless steel wires are shipped in most cases in units of a coil of such a small weight as 20 Kg or 30 Kg based on a request from a user side. Winding apparatus for winding a wire in units of a coil of a predetermined amount are conventionally divided into two types including the upwardly taking up type in which a finish drum is employed and the downwardly taking up type in which a IV inverted type winder is employed. A conventional winding apparatus of the upwardly taking up type is shown in Figs. 8 and 9(A) to 9(C). Referring to Figs. 8 and 9(A) to 9(C), a guide member 41 is mounted on a finish drum 35 of a wire drawing machine so that a wire 7 wound around the finish drum 35 is stored directly on the finish drum 35 along the guide member 41. After the wire 7 is wound up to a predetermined amount, the wire drawing machine is stopped, and a coil unit 8 of the thus wound-up product is unloaded using a holding hook 42 called a stripper.

Meanwhile, a conventional winding apparatus of the downwardly taking up type is shown in Figs. 10(A) and 10(B). Referring to Figs. 10(A) and 10(B), a wire 7 is wound around a downwardly directed capstan 44. After the wire 7 is wound several turns, it is dropped onto a take-up frame 2 called a stem located below the capstan 44 (refer to Fig. 10(A)). After the wire 7 is wound a predetermined amount onto the take-up frame 2 in this manner, the wire drawing machine is stopped, and then the take-up frame 2 is taken out by means of a crane such as a hoist. Then, the wire 7 wound up on the take-up frame 2 is bundled (refer to Fig. 10(B)) and unloaded from the take-up frame 2. Thereafter, the take-up frame 2 is placed in the position below the capstan 44 again, and the wire drawing machine is re-started to repeat winding operation.

In the conventional wire winding apparatus of the upwardly and downwardly taking-up types described above, in order to bundle a wound-up wire, each time the wire is wound a predetermined length for a coil unit 8, the wire drawing machine must be stopped to unload the product. Accordingly, the conventional winding apparatus are very

low in operability and productivity. Further, when the wire drawing machine is restarted after it is stopped, the free coil diameter (diameter of a coil when no force is applied to the wire) of the wire 7 is liable to vary, which makes the wound-up profile of the coil unit 8 irregular. Therefore, the conventional winding apparatus have another problem in that an amending operation such as measuring and adjusting the coil diameter again is required.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a wire winding apparatus which can continuously wind up a wire into a plurality of bundles readily and with certainty without interrupting operation of the apparatus and can achieve labour saving, improvement in productivity and improvement in quality at a reduced cost.

In order to attain the object described above, according to the present invention, there is provided a wire winding apparatus for winding a wire delivered from a wire delivery means such as a finish drum of a wire drawing machine to form a plurality of coils each in the form of a bundle, interposing a spacer each time when a coil unit constituted from a predetermined amount of the wire is accumulated. The wire winding apparatus comprises a turntable mounted for rotation around a vertical axis, a take-up frame carried for coaxial integral rotation on the turntable for taking up the wire delivered thereto, and a spacer supply means provided coaxially above the turntable for supporting thereon a plurality of spacers each generally in the form of a perforated plate in such a manner as to allow, each time the wire with a predetermined length is taken up into a coil unit on the take-up frame, a spacer to drop therefrom so that the spacer may be loosely fitted onto a stem winding portion of the take-up frame, thereby to interpose the spacer between adjacent coil units.

The wire winding apparatus may be constructed such that the spacer supply means includes a support bar extending radially in horizontal directions from an extension line of the vertical axis of the turntable and rotatable around the extension line for supporting from below a plurality of spacers placed one on another horizontally and coaxially with the vertical axis at least at two points in the proximity of a circumferential edge of the center hole of the spacers, and a driving apparatus for reversibly rotating the support bar between positions of two supporting points spaced by a fixed angle of rotation from each other, and formed with such a size as to allow it to pass an internal space of the stem winding portion of the take-up frame and connected for integration rotation to the turntable, and the spacers include two different types

of spacers each of which has at least two slits formed at the circumferential edge of the center hole of the spacer in such a manner as to allow supporting portions of the support bar to pass there but said slits are displaced in rotational phase by the fixed angle of rotation between adjacent spacers and are placed one on another on the support bar at the two supporting points such that the slits of the spacers are displaced alternately by the fixed angle of rotation but every other one of the spacers have the same type of phase.

Preferably, each of the spacers has a plurality of grooves formed to extend in radial directions from an inner circumferential edge to an outer circumferential edge on an upper face thereof so as to pass a bundling wire therethrough.

In accordance with the present invention, the wire winding apparatus comprises a turntable mounted for rotation around a vertical axis, a take-up frame mounted for coaxial integral rotation on the turntable, and a spacer supply means for allowing each time when a wire is taken up into a coil unit on the take-up frame, a spacer to drop therefrom so as to interpose the spacer between adjacent coil units. Upon winding a wire into coils, a product does not need to be taken out each time the wire is taken up to a predetermined length, but each time the wire is taken up to the predetermined length onto the take-up frame, a spacer which functions as a mark is dropped and thrown into the taken-up wire without stopping or decelerating a wire drawing machine from which the wire is supplied to the wire winding apparatus. Accordingly, a plurality of coil units can be accumulated successively until the wire winding apparatus reaches to the full capacity. Consequently, the frequency of stopping of the wire drawing apparatus and/or the wire winding apparatus and the frequency of taking out of products are reduced significantly when compared with those of conventional wire winding apparatus. After the wire is taken up to the full capacity of the wire winding apparatus in this manner, the wire winding apparatus (and the wire drawing machine) is stopped once, and the take-up frame replaced with a new take-up frame, whereafter operation of the wire winding apparatus is resumed with the new take-up frame. Meanwhile, the wire taken up on the take-up frame is bundled, as another operation independent of winding operation, to each coil unit of the predetermined amount of the wire divided by a spacer interposed in the taken up wire, and the coil units are separated from each other and packaged suitably. Accordingly, the operation efficiency and the labour saving effect of the wire winding apparatus are high.

Where the wire winding apparatus is constructed such that the spacer supply means includes a

support bar for supporting from below a plurality of spacers placed one on another above the turntable horizontally and coaxially with the vertical axis at least at two points in the proximity of a circumferential edge of the center hole of the spacers, and a driving apparatus for reversibly rotating the support bar between positions of two supporting points spaced by a fixed angle of rotation from each other, and is formed with such a size as to allow it to loosely pass an internal space of the winding portion of the take-up frame and connected for integration rotation to the turntable, and the spacers include two different types of spacers each of which has at least two slits formed at the circumferential edge of the center hole of the spacer in such a manner as to allow supporting portions of the support bar to pass there but said slits are displaced in rotational phase by the fixed angle of rotation between adjacent spacers, and are placed one on another on the support bar at the two supporting points such that the slits of the spacers are displaced alternately by the fixed angle of rotation but every other one of the spacers have the same type of phase, only one of the spacers which is rotated coaxially together with the take-up frame can be allowed to drop only by causing the support bar to perform a simple operation of rotating with the small fixed angle of rotation. Consequently, a spacer can be interposed at a good timing to a predetermined location even during high speed winding operation.

Where each of the spacers has a plurality of grooves formed to extend from an inner circumferential edge to an outer circumferential edge on an upper face thereof so as to pass a bundling wire therethrough, at the time of operation other than the wire winding operation, a bundling operation for each coil unit can be performed simply and readily by a single operator.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which like parts or elements are denoted by like reference characters.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1

is a front elevational view showing, partly in section, essential part of a wire winding apparatus according to a preferred embodiment of the present invention;

Fig. 2

is a plan view of a spacer of the wire winding apparatus shown in Fig. 1;

Fig. 3

is a sectional view taken along line A-A of Fig. 2

and showing the spacer;

Fig. 4

is a partial plan view of another spacer of the wire winding apparatus shown in Fig. 1;

Fig. 5

is a plan view illustrating the relationship in arrangement between the spacers and a support bar of the wire winding apparatus shown in Fig. 1;

Fig. 6

is a flow chart illustrating a procedure of a spacer supplying operation of the wire winding apparatus shown in Fig. 1;

Figs. 7(A) to 7(C)

are schematic views illustrating different wire length measuring methods employed to supply a spacer in the wire winding apparatus of Fig. 1;

Fig. 8

is a front elevational view showing a finish drum of a conventional wire drawing machine;

Figs. 9(A) to 9(C)

are schematic views illustrating an upward winding operation of the conventional wire drawing machine shown in Fig. 8; and

Figs. 10(A) and 10(B)

are schematic views illustrating a downward winding operation of another conventional wire winding apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to Fig. 1, there is shown a wire winding apparatus according to a preferred embodiment of the present invention. The wire winding apparatus shown includes a turntable 1, a take-up frame 2, and spacer supply means 3, and is located on the downstream side of wire delivery means including a finish drum 35 and so forth shown in Figs. 7(A) to 7(C). The turntable 1 has, for example, such a structure that a body portion 1B in the form of a circular cylinder is erected uprightly at a central portion of a table 1A in the form of a perforated disk. The turntable 1 is fitted on a vertical center shaft 6, which extends vertically upwardly from a base 5, with a pair of bearings 11 and 12 interposed therebetween so that it may rotate around the vertical center shaft 6. The turntable 1 is rotated around the vertical center shaft 6 by a motor 16 by way of a gear 13 provided coaxially and integrally with the table 1A, another gear 14 held in meshing engagement with the gear 13 and a bevel gear train 15 connected to the gear 14.

The take-up frame 2 has a substantially same structure as those employed in conventional wire winding apparatus. Referring to Figs. 10(A) and 10(B), the take-up frame 2 is formed as a tubular frame member formed from thick round steel bars

as materials by bending and welding processes of them and including a winding portion 22 including three or more, for example, four, struts extending along an imaginary cylinder and a base portion 21 including four bent portions extending like petals within an imaginary annular plate and integrated with the winding portion 22. The take-up frame 2 is mounted on and secured to the turntable 1 by suitable means such that the base portion 21 is supported on the table 1A and the winding portion 22 is positioned concentrically around the body portion 1B so that the take-up frame 2 can rotate integrally and concentrically with the turntable 1 around the vertical center shaft 6.

Meanwhile, the spacer supply means 3 is disposed just above the turntable 1 and is mounted on a frame 23 having a topped cylindrical shape and integrally secured to an upper end portion of the body portion 1B so that it can rotate integrally with the turntable 1. The spacer supply means 3 includes four support bars 9, and a driving apparatus 10 for reversibly rotating the support bars 9 with a fixed angle of rotation. Each of the support bars 9 is formed, for example, from a round steel bar of a predetermined length. The four support bars 9 are individually fitted loosely in four slits 30 perforated in a horizontally elongated shape in the frame 23 and are mounted in a cantilever configuration on a rotary shaft of a pneumatic rotary actuator 24 which is secured to an intermediate support plate 31 of the frame 23 and directed downwardly coaxially with the vertical center shaft 6. The four support bars 9 are disposed radially in horizontal directions from an extension line of the vertical center shaft 6 such that they may make a cross.

The driving apparatus 10 is formed as a pneumatically operated driving apparatus including the rotary actuator 24, a rotary joint 25 mounted coaxially at an upper end of the vertical center shaft 6, a pair of air passages 28 and 29 formed in an axial direction in the vertical center shaft 6, an electromagnetic directional control valve 26, and a pressure air source 27. The rotary actuator 24 reversibly rotates the rotary shaft thereof with a fixed angle of rotation, for example, in the present embodiment, with a reversible angle of 8° the compressed air is supplied to it with the flowing direction thereof reversed alternately. The rotary joint 25 has two fixed side ports connected to ends of the air passages 28 and 29 and two rotatable side ports connected to corresponding ports of the rotary actuator 24. The electromagnetic directional control valve 26 has a pressure source port connected to the pressure air source 27, with a tank port left open, and a pair of actuator ports connected to the other ends of the air passages 28 and 29.

In the spacer supply means 3 constructed in such a manner as described above, the spacer supply means 3 is rotated together with the turntable by driving the motor 16, by changing operation of the electromagnetic directional control valve 26 while compressed air is supplied to the rotary actuator 24 through the rotary joint 25 so that the rotary shaft of the rotary actuator 24 is reversibly rotated in the clockwise direction or the counterclockwise direction with a reversible angle of 8° to reversibly rotate the four support bars 9 integrally therewith with reversible angle of 8°.

It is to be noted that, in the embodiment shown in Fig. 1, a supporting bar 34 is secured at a central portion on the top of the frame 23 by means of a screw and a pair of centering shafts 20 are mounted on and suspended from the both ends of the supporting bar 34. The centering shafts 20 are provided in order to adjust the phases of a plurality of spacers 4 placed on the support bars 9 concerning the direction of rotation of them to each other.

The spacers 4 employed in the wire winding apparatus of the present embodiment are divided into two types: one of them is a spacer 4A shown in plan in Fig. 2 and shown also in Fig. 3 which is a cross section view taken along line A-A of Fig. 2; and the other is a spacer 4B partially shown in plan in Fig. 4. The spacers 4, that is, the spacers 4A and 4B, are produced in desired shapes using, as a material, a plate of a light-weighted material having a high workability such as, for example, an MC nylon resin of an engineering plastic, wood or aluminum.

Each of the spacers 4A and 4B shown in Figs. 2 to 4 is formed from an annular plate 33 generally in the form of a perforated plate having four plate pieces 32 provided integrally at four circumferentially equally spaced locations and extending radially such that they may cross perpendicularly with each other. The plate pieces 32 are formed in such a shape that the inner diameter of inner circumferential edges is greater than the outer diameter of the frame 23 but smaller than the length of the support bars 9 while the outer diameter of the plate pieces 32 circumferential edges thereof is greater than the length of the support bars 9 and preferably a little greater than the outer side diameter of the coil unit 8 to be taken up around the take-up frame 2. It is to be noted that it is necessary that the inner diameter of the annular plate 33 be greater than the outer diameter of the frame 23, and in the present embodiment, the inner diameter of the annular plate 33 is substantially equal to the length of the support bars 9.

Each of the spacers 4A and 4B has, at each plate piece 32 thereof, a groove 17, a slit 18 and a round hole 19. The groove 17 is formed concave

on an upper face of each plate piece 32 and extends radially from the inner to outer circumferential edges along a center line of the plate piece 32. The grooves 17 are located at same positions of the spacers 4A and 4B, and in particular, at positions circumferentially spaced from each other by 90 degrees on two perpendicular center lines of the spacers 4A and 4B. The grooves 17 are utilized as passages for guiding a bundling wire in order to wrap the bundling wire on a surface of the coil unit 8.

Meanwhile, the slit 18 is formed as a narrow elongated hole formed to extend from the inner circumferential edge of each plate piece 32 at a location corresponding to a support bar 9, and the slits 18 of the plate pieces 32 are provided at location circumferentially spaced by 90 degrees from each other on the two perpendicular center lines of the spacers 4A and 4B so that the four support bars 9 may pass through the slits 18 at a time. The slits 18 are provided, in the spacer 4A of the first type, at locations displaced by 3° to the left side in the counterclockwise direction of the grooves 17, but in the spacer 4B of the second type, at locations displaced by 5° to the right side in the clockwise direction. Consequently, the slits 18 are provided in a rotational phase relationship in which they are displaced by an angle corresponding to reversible rotation angle of 8° of the support bars 9 between the spacers 4A and 4B.

The round holes 19 are provided at same locations of the spacers 4A and 4B. In particular, the round holes 19 are provided at locations spaced equally from the center of the spacers and displaced by same rotational angles from the grooves 17, for example, at locations spaced by 5° to the right side in the clockwise direction. The round holes 19 are formed as holes having a suitable diameter to allow the centering shafts 20 to be loosely fitted therein.

A winding operation of the wire winding apparatus of the present embodiment will be described below with reference to Fig. 1, Fig. 5 which is a plan view and illustrates the relationship in arrangement between the spacers 4 and the support bars 9 and Fig. 6 which is a flow chart illustrating different steps of the operation in an order. While the supporting bar 34 is removed, the spacers 4A and 4B are placed alternately onto the support bars 9 and positioned such that the round holes 19 thereof may be aligned with each other. Then, the pair of centering shafts 20 are inserted into pairs of diametrically opposing ones of the round holes 19, and the supporting bar 34 is secured to the frame 23. Consequently, the spacers 4A and 4B are placed on the support bars 9 such that the round holes 19 thereof are aligned with each other and the slits 18 thereof are displaced by

the fixed rotational angle of 8° between each adjacent ones of the spacers 4A and 4B while the slits 18 between each every other ones of the spacers 4A and 4B have a same phase and the support bars 9 correspond to two supporting points spaced by 8° from each other. In this condition, the spacer 4A at the lowermost stage which is supported in direct contact with the support bars 9 is naturally positioned such that the slits 18 thereof are displaced by 8° from the corresponding support bars 9.

Here, a value of a length of the wire 7 for one bundle is set to a wire length counter (step S1), and then, a number of bundles to be wound up onto the take-up frame 2 is set to a bundle number counter (step S2). Then, the motor 16 is started to rotate the turntable 1 and the take-up frame 2 to start a winding operation (step S3) to cause the take-up frame 2 to take up the wire 7 delivered at a predetermined speed from the wire delivery means. Simultaneously, the wire length counter is started to measure the length of the thus delivered wire 7 (step S4). The thus delivered wire 7 is wound around an upper portion of the winding portion 22 of the take-up frame 2 and drops while being rotated around the take-up frame 2 so that it is accumulated into a coil on the base portion 21. When a predetermined amount of the wire 7 is taken up so that the predetermined wire length is reached to form a coil unit 8, the wire length counter detects this and outputs and output signal (step S5). In response to the output signal of the wire length counter, the electromagnetic reversible control valve 26 is automatically changed over to drive the rotary actuator 24 and the wire length counter is reset (step S6). As a result, the support bars 9 are rotated by 8° . Consequently, the spacer 4A at the lowermost stage comes to a position at which the slits 18 thereof are aligned with the support bars 9 and accordingly it is not supported by the support bars 9 anymore. Consequently, during the winding operation, only the spacer 4A at the lowermost stage drops passing the support bars 9 until it is received by the coil unit 8 around the winding portion 22 of the take-up frame 2.

In this instance, since the spacer 4A drops while being rotated synchronously with the turntable 1 and the take-up frame 2, it will not be caught at all by an intermediate portion of the winding portion 22 and can smoothly move and be received by the coil unit 8 with certainty. After the spacer 4A at the lowermost stage drops, a winding operation is continued. On the other hand, on the spacer supply means 3 side, the spacers including the spacer 4B at the next stage are supported on the support bars 9, and the bundle number counter is incremented by one (step S7). Until after the bundle counter detects that the designated number

of bundles are taken up (step S8), the operations at steps S4 to S7 are repeated in a similar manner as described above. In this instance, the rotary actuator 24 is driven reversely to allow the spacer 4B at the next stage to drop. In this manner, each spacer 4 drops onto a coil unit 8 at a given time while being rotated together with the take-up frame 2. Then, after the designated number of bundles are taken up, the winding operation is stopped, and the bundle number counter is reset (step S9).

By the way, if it is assumed that, with a conventional wire winding apparatus wherein the take-up frame 2 is moved out and in each time a coil unit 8 is wound up, about 15 minutes are required for the operation for moving the take-up frame 2 out and in, then with the wire winding apparatus of the present embodiment, if a total of six coil units 8 are obtained in a single continuous taking up operation, then five operations for moving the take-up frame 2 out and in become unnecessary, and consequently, the time required for taking up six coil units can be reduced by a total of $15 \times 5 = 75$ minutes, that is, by more than one hour.

Figs. 7(A) to 7(C) illustrate different wire length measuring methods used in order to supply spacers in the wire winding apparatus of the present embodiment. In the method illustrated in Fig. 7(A), the speed of rotation of the finish drum 35 of the wire drawing machine is detected by a rotary encoder 36, and the value of the thus detected speed is used to calculate the length of the wire 7 by a programmable logic controller (PLC) 37. In particular, the programmable logic controller 37 performs a calculation of the wire length = diameter of the finish drum 35 $\times$ 3.14 $\times$ speed of rotation and, when the value obtained by the calculation reaches the present wire length, the programmable logic controller 37 sends a signal to the electromagnetic directional control valve 26 so that a spacer 4 is thrown in and supplied. In the meantime, in the method illustrated in Fig. 7(B), the wire 7 being supplied is wrapped around a length measuring wheel 38 disposed between the finish drum 35 of the wire drawing machine and the winding apparatus, and the speed of rotation of the length measuring wheel 38 is detected by the rotary encoder 36. Then, the wire length is calculated and a spacer 4 is thrown in and supplied in a similar manner as in the method of Fig. 7(A) described above. On the other hand, in the method illustrated in Fig. 7(C), the speed (length) of the wire 7 which is fed between the finish drum 35 of the wire drawing machine and the winding apparatus is measured by an optical length measuring instrument 39 (calculated by a control unit 40 for exclusive use), and when a pre-set wire length is reached, a signal is sent out from the programmable logic controller 37 to the electromagnetic directional control valve 26

to thrown in and supply a spacer 4 in a similar manner as in the methods of Figs. 7(A) and 7(B). A spacer 4 can be supplied at a suitable timing with certainty for each coil unit 8 in this manner.

While, in the embodiment described above, the spacer supply means 3 is shown as an apparatus of the type which is controlled by a pneumatic circuit, the present invention is not limited to the apparatus of such a specific form, and it is also possible to modify the wire winding apparatus of the embodiment such that the mechanism for reversibly rotating the support bars 9 includes an electromagnetic solenoid to which power is supplied by way of a slip ring or an electromechanical conversion apparatus including a motor, for example, a stepping motor. Also such modifications are included in the scope of the present invention.

Having now fully described the invention, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the spirit and scope of the invention as set forth herein.

Claims

1. A wire winding apparatus for winding a wire delivered from a wire delivery means such as a finish drum of a wire drawing machine to form a plurality of coils each in the form of a bundle and interposing a spacer each time when a coil unit constituted from a predetermined amount of the wire is accumulated thereon, comprising:

a turntable mounted for rotation around a vertical axis;

a take-up frame mounted for coaxially integral rotation on said turntable for taking up the wire delivered thereto; and

a spacer supply means provided coaxial above said turntable for supporting thereon a plurality of spacers each generally in the form of a perforated plate in such a manner as to allow, each time when the wire is taken up into a coil unit on said take-up frame, a spacer to drop therefrom so that the spacer may be loosely fitted onto a stem winding portion of said take-up frame thereby to interpose the spacer between adjacent coil units.

2. A wire winding apparatus according to claim 1, wherein said spacer supply means includes a support bar extending radially in horizontal directions from an extension line of the vertical axis of said turntable and rotatable around the extension line for supporting from below a plurality of spacers placed one on another horizontally and coaxially with the vertical axis at least at two points in the proximity of a circum-

ferential edge of the center hole of the spacers and a driving apparatus for reversibly rotating said support bar between positions of two supporting points spaced by a fixed angle of rotation from each other, and formed with such a size as to allow it to pass an internal space of said winding portion of said take-up frame and connected for integration rotation to said turntable, and the spacers include two different types of spacers each of which has at least two slits formed at the circumferential edge of the center hole of the spacer in such a manner as to allow supporting portions of said support bar to pass there but said slits are displaced in rotational phase by the fixed angle of rotation between adjacent spacers and are placed one on another on said support bar at the two supporting points such that the slits of the spacers are displaced alternately by the fixed angle of rotation but every other one of the spacers have the same type of phase.

3. A wire winding apparatus according to claim 2, wherein each of the spacers has a plurality of grooves formed to extend in radial directions from an inner circumferential edge to an outer circumferential edge on an upper face thereof so as to pass a bundling wire therethrough.

FIG. 1

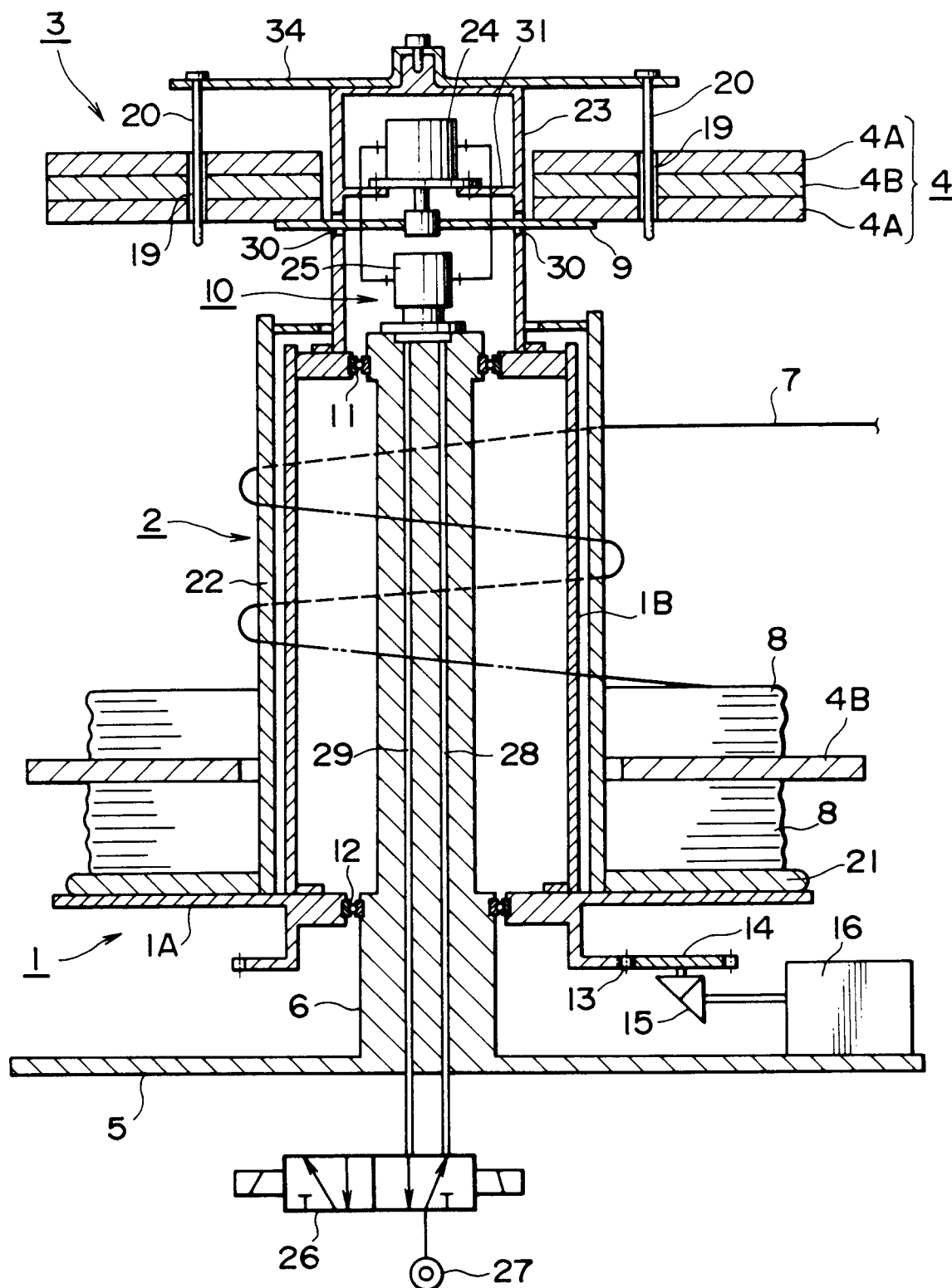


FIG. 2

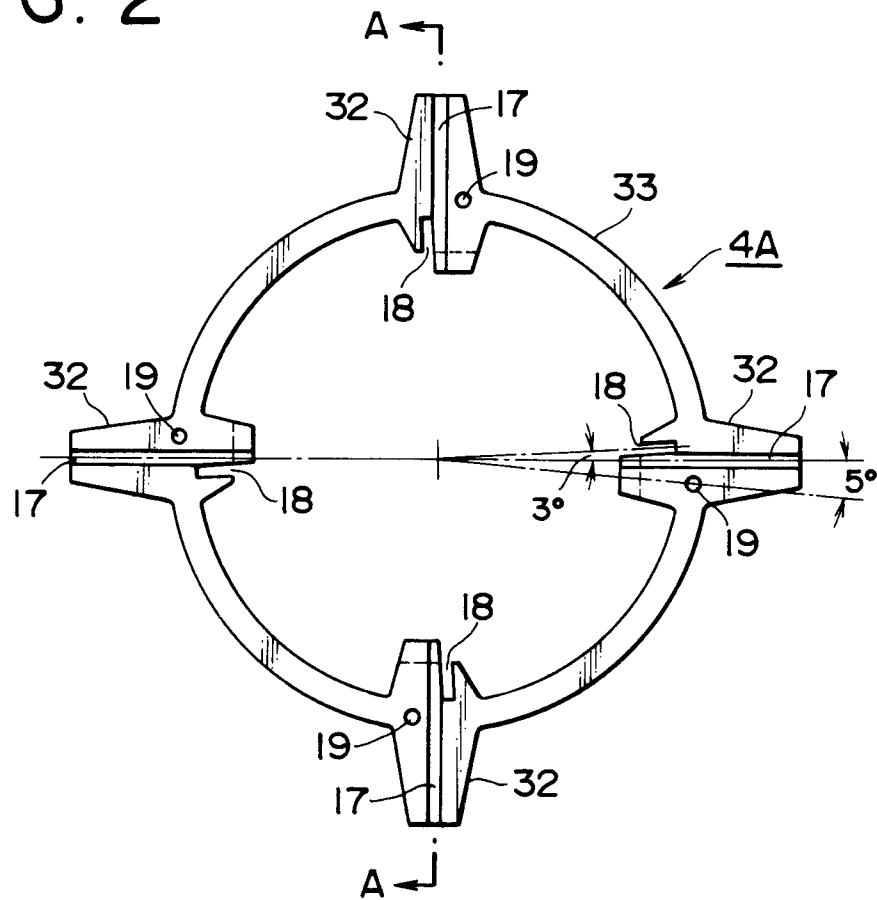


FIG. 3

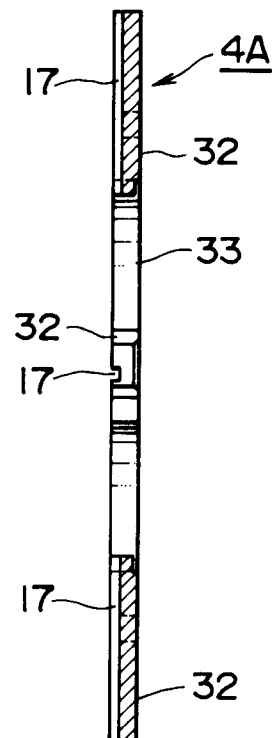


FIG. 4

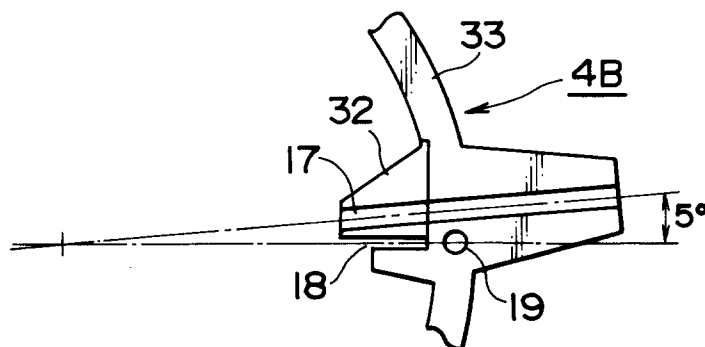
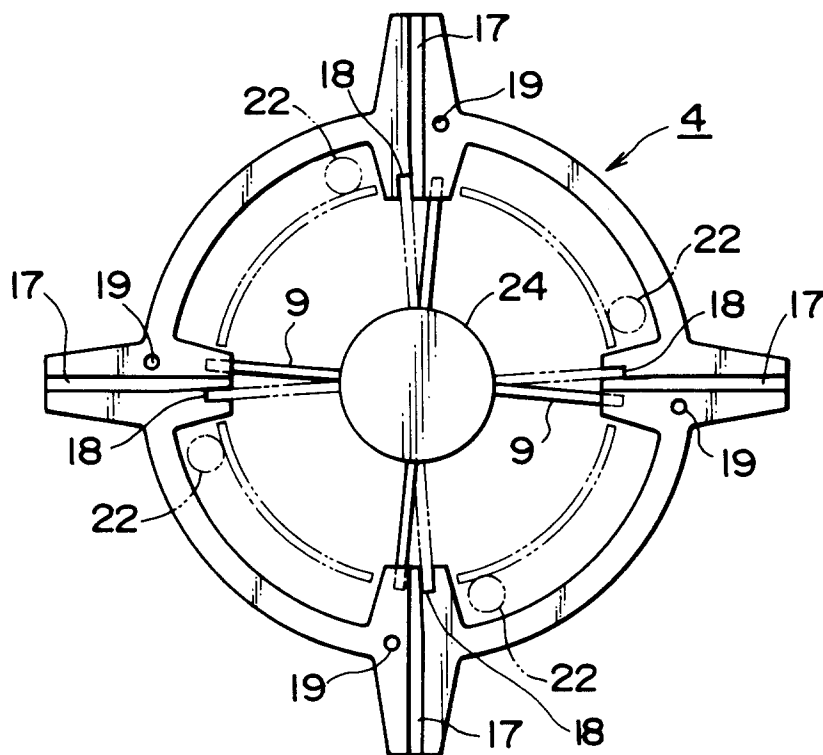


FIG. 5



FLOW CHART FOR
AUTOMATIC OPERATION

FIG. 6

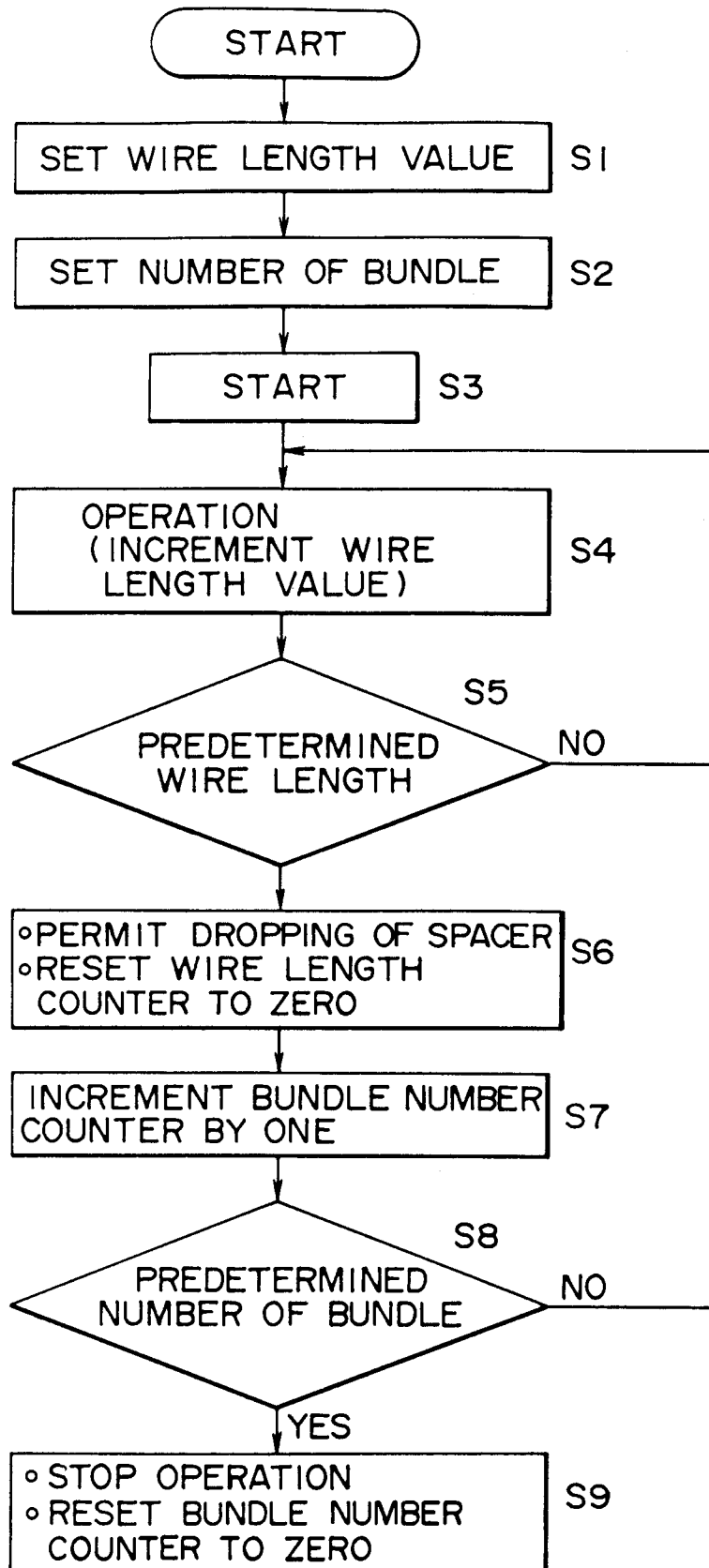


FIG. 7(A)

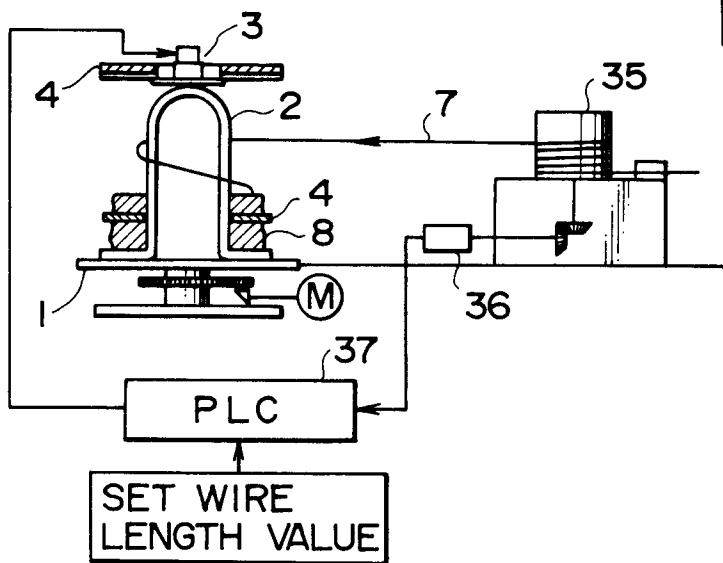


FIG. 7(B)

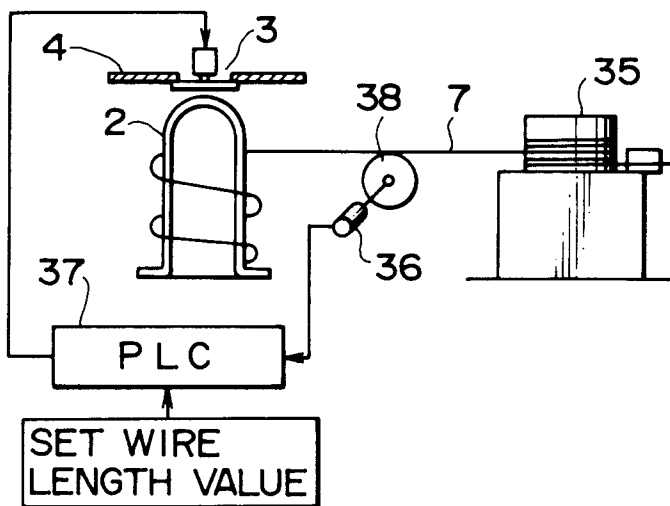


FIG. 7(C)

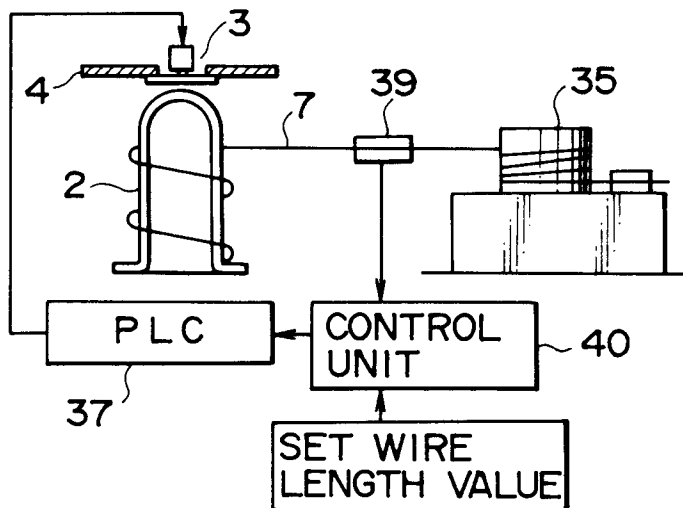


FIG. 8

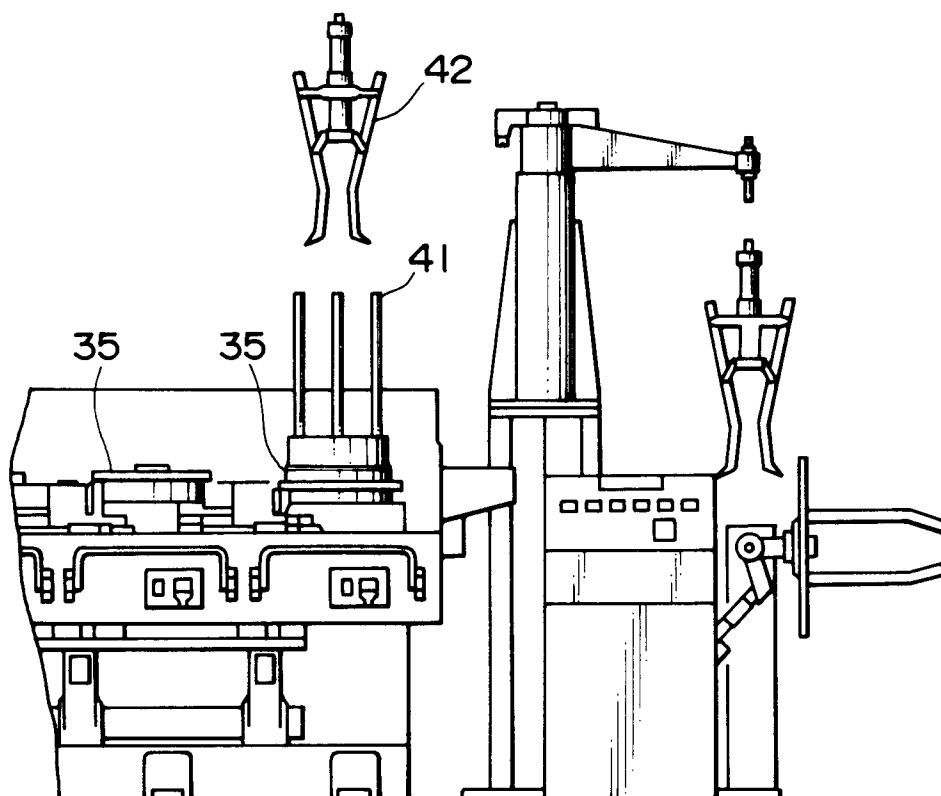


FIG. 9(A)

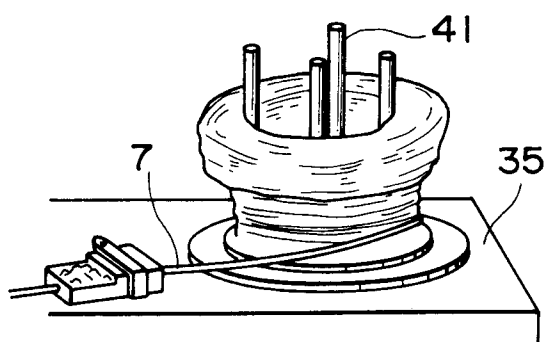


FIG. 9(B)

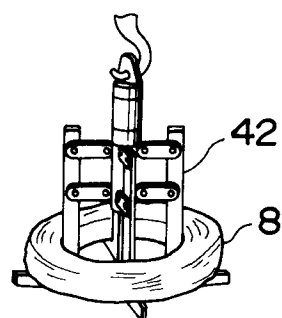


FIG. 9(C)

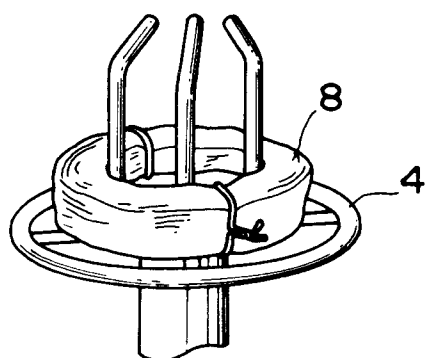


FIG. 10(A)

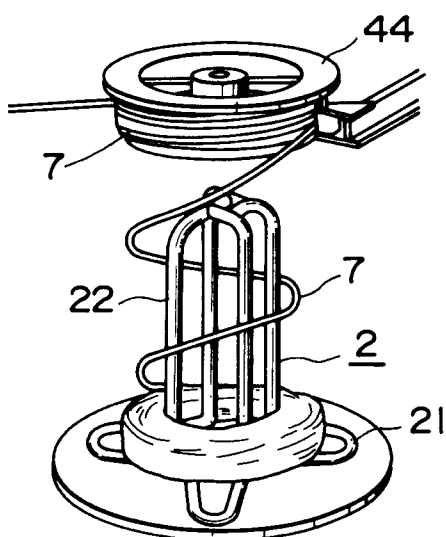
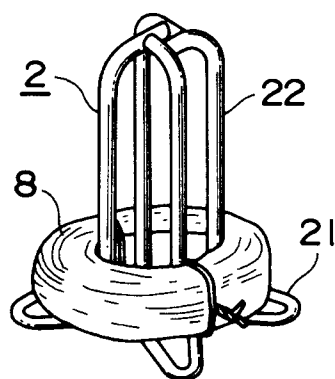


FIG. 10(B)





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 1785

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.6)
A	US-A-2 743 066 (CRUM) * column 2, line 26 - line 58; figures * ---	1	B21C47/04 B21C47/00 B65H55/00
A	FR-A-1 456 522 (SOUTHWIRE COMPANY) * page 6, right column, paragraph 4 - page 7, left column, paragraph 1; figures 13-16 *	1	
A	DE-A-538 468 (SUDDEUTSCHE KABELWERKE) * claims; figures * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B21C B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 June 1995	Examiner Barrow, J
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	