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(71) Applicant:
FUJI PHOTO FILM CO., LTD.
Kanagawa (JP)

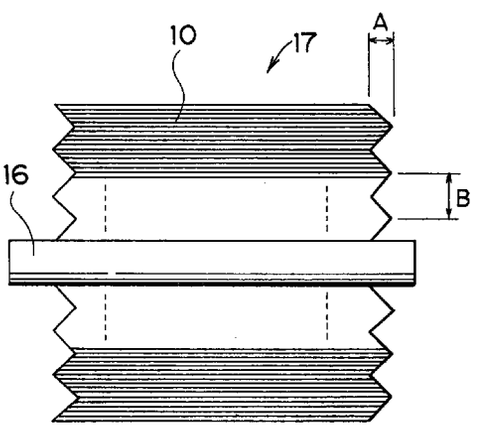
(72) Inventors:
- **Fujita, Hiroshi**
  Minami-Ashigara-shi, Kanagawa (JP)
- **Fujikura, Daisuke**
  Minami-Ashigara-shi, Kanagawa (JP)
- **Ohno, Takashi**
  Minami-Ashigara-shi, Kanagawa (JP)

(74) Representative:
Grünecker, Kinkeldey,
Stockmair & Schwanhäusser
Anwaltssozietät
Maximilianstrasse 58
80538 München (DE)

(54) Web winding method and apparatus

(57) A web (10) is wound on a core (16) into a web roll (17) while being traversed in a width direction of the web (10) at a predetermined cycle and amplitude so that each end face of the web roll (17) can have corrugations of predetermined form. The web (10) is wound with both edges thereof being staggered. Thus, if the thickness of the web (10) is uneven in the width direction, thick parts and thin parts are alternately layered, so that the web (10) can be wound under an even pressure, and the web roll (17) can have good form. Since the end face of the web roll (17) has the corrugations of predetermined form (for example, sawtooth form), the web (10) can be prevented from slipping on the web roll (17), and the web roll (17) can be suitable for transportation.

F I G. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a web winding method and apparatus, and more particularly to a web winding method and apparatus for winding, on a core, web which is knurled at both edges or one edge thereof and/or which is of uneven thickness.

Description of Related Art

The form of a roll of web, which is wound on a core, greatly influences the quality or the value of the web. Hence, web must be wound into rolls which have good form.

The form of a web roll basically depends on the properties of the web. That is to say, in the case of the web of substantially even thickness, the web can be wound into the web roll of good form. If, however, the thickness of the web is uneven in the width direction of the web (the edges at both sides of web are usually thick), or if the web is knurled at edges thereof, the winding pressure is uneven and then the web roll may have bad form. In this case, the web is wound into the web roll which swells in both edges, and thereby the web is stretched and/or folded at the edges.

A variety of measures have been taken to wind the web of uneven thickness or the web which is knurled at edges thereof into rolls of good form. For example, Japanese Patent Provisional Publication No. 58-100049 discloses a web winding method in that both edges of the web are cut in sawtooth form before the web is wound. In this method, the edges can be prevented from overlapping. This method, however, has a disadvantage in that the winding apparatus is complicated and large because there must be an additional step of cutting the edges.

Japanese Patent Provisional Publication No. 62-222954 discloses another web winding method in that the web is wound while being traversed in the width direction of the web with the traverse amount and the web making conditions being related to one another. In this method, the thick and thin parts of the web are layered so that the winding pressure can be even as a whole. This method, however, has a disadvantage in that the web slips on the web roll of the wound web and it is difficult to transport the web rolls with keeping them upright.

SUMMARY OF THE INVENTION

The present invention has been developed in view of the above-described circumstances, and has as its object the provision of a web winding method and apparatus which is able to prevent wound web from being stretched and folded at edges thereof, and which is able to wind the web into rolls which have form good and suitable for transportation.

To achieve the above-mentioned object, a web winding method of the present invention for winding web on a core into a roll comprises: winding the web on the core while traversing at least one of the web and the core at a predetermined cycle and a predetermined amplitude in a width direction of the web so that each of end faces of the roll can have corrugations of predetermined form.

According to the present invention, web is wound on a core into a web roll while at least one of the web and the core is traversed in the width direction of the web at predetermined cycle and amplitude so that each end face of the web roll of the web can have corrugations of predetermined form. The form of the end face of the web roll is determined according to purposes. If the end face has corrugations of predetermined form, it is possible to prevent the web from slipping on the web roll and make the transportation of the web roll more convenient.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature of this invention, as well as other objects and advantages thereof, will be explained in the following with reference to the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures and wherein:

Fig. 1 is a side view illustrating the construction of a web winding apparatus according to the present invention;
Fig. 2 is a plan view illustrating the construction of a traverse device;
Fig. 3 is a view describing a web winding method by a cross sectional view of a roll;
Figs. 4(A), 4(B) and 4(C) are views describing the form of end faces of rolls of wound web as the cross sectional views of the rolls;
Fig. 5 is a front view illustrating the construction of a device for interchanging guide rollers;
Fig. 6 is a plan view of Fig. 5; and
Fig. 7 is a side view of Fig. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention will be described in further detail by way of example with reference to the accompanying drawings.

Fig. 1 is a side view illustrating the construction of an embodiment of a web winding apparatus according to the present invention. As shown in Fig. 1, web 10 is transferred to the left in the drawing and is wound on a core 16 into a web roll 17. The web 10 is guided by a plurality of guide rollers 12, which are arranged in a

transfer line, and is traversed in a width direction of the web 10 at predetermined cycle and amplitude by a traverse device 14, which is provided in the transport line.

Fig. 2 is a plan view illustrating the construction of the traverse device 14. As shown in Figs. 1 and 2, the traverse device 14 has four fixed rollers 18, which are arranged symmetrically, and a pair of swinging rollers 20, which are arranged between the fixed rollers 18. The fixed rollers 18 are rotatably supported by a body frame (not illustrated), and one end of each swinging roller 20 is rotatably supported by a swinging frame 22. One end (the left end in the drawing) of the swinging frame 22 connects to the body frame via a pin 24. The other end of the swinging frame 22 connects to a rod of a hydraulic cylinder 26 via a pin 27. The hydraulic cylinder 26 is controlled by a control unit 28, and the hydraulic cylinder 26 swings the swinging frame 22 in response to a drive signal output from the control unit 28.

When the hydraulic cylinder 26 is driven, the swinging frame 22 swings on the pin 24, and the swinging rollers 20 swing as a result. When the swinging rollers 20 swing, the web 10 follows their movement. Thus, the web 10 is traversed in a direction perpendicular to the transport direction, that is, in the width direction of the web 10.

A description will be given of the operation of the embodiment of the web winding apparatus according to the present invention.

The web 10 is transferred from the right in Fig. 1 and is wound on the core 16 into the web roll 17 while being guided by the guide rollers 12 and traversed by the traverse device 14 in the width direction of the web 10.

In the traverse device 14, the control unit 28 drives the hydraulic cylinder 26 so that the swinging frame 22 connected to the hydraulic cylinder 26 can swing on the pin 24. When the swinging frame 22 swings, the swinging rollers 20 supported by the swinging frame 22 swing. Thus, the web 10 follows the swinging rollers 20, and the web 10 is traversed in the width direction of the web 10 as a result.

When the web 10 which has been traversed in the width direction is wound on the core 16, the web 10 is piled on the core 16 with the edges of the web 10 being staggered, and thereby each end face of the web roll 17 has concentric circular corrugations. When the web which is knurled at both edges or one edge thereof and/or which is of uneven thickness is wound, the thick part and the thin part of the web are alternately piled, so that the winding pressure can be even and the web can be wound into the web roll which has good form.

When the web is coated with a photosensitized material and is between 30 μm and 300 μm in thickness, the amplitude for traversing the web is set within a range between 1 mm and 20 mm so that the web 10 can be efficiently wound. In particular, if the set amplitude is larger than the knurl width (5 - 15 mm × 1 - 50 μm) or the width of the uneven coatings (between 1 % and 20 % of the web thickness), a remarkable effect can be achieved.

Fig. 3 is a schematic sectional view of the web roll 17 along the axis thereof. As shown in Fig. 3, if the web 10 is traversed at the amplitude which is determined as stated above (between 1 mm and 20 mm) and wound, an amplitude (the difference between the highest point and the lowest point) A of the corrugations on each end face of the web roll 17 is the same as the above-mentioned set amplitude (between 1 mm and 20 mm), that is, the amplitude for traversing the web 10 in the width direction of the web 10.

The web 10 can be efficiently wound if the cycle for traversing the web 10 is determined so that a cycle (intervals between a top and the next top) B of the corrugations on each end face of the web roll 17 can be within a range between 5 mm and 200 mm. The cycle for traversing the web 10 may be gradually extended so as to maintain the cycle B of the corrugations at a constant length. In order to wind the web 10 more efficiently, the cycle B of the corrugations is preferably set within such a small range as to prevent the products from being folded or wrinkled.

As stated above, the cycle and amplitude for traversing the web 10 are determined according to the types, properties, etc. of the wound web 10. According to purposes, it is possible to make various forms of the corrugations on the end faces of the web roll 17, which are formed through the winding of the web 10 with the traversing at the cycle and amplitude determined as stated above. The properties of the web, which has been wound in the web roll, are changed according to the types of corrugations on the end faces of the web roll.

Figs. 4(A), 4(B) and 4(C) show typical examples of corrugations on the end face of the web roll. As shown in the drawings, there are various forms of the corrugations on the end faces of the web roll. For example, the corrugations can be sine wave form (see Fig. 4(A)) and sawtooth form (see Fig. 4(B)), and the highest and lowest parts of the corrugations may be flat (see Fig. 4(C)).

By forming the corrugations, the web can be prevented from being stretched or folded at edges thereof and the web can be wound under an even winding pressure. Furthermore, if the corrugations are sine wave form as shown in Fig. 4(A), the equipment cost can be lower. If the corrugations are sawtooth form as shown in Fig. 4(B), the web can be prevented from slipping on the web roll. If the highest and lowest parts of the corrugations are flat as shown in Fig. 4(C), the web roll is suitable for transportation with keeping the web roll upright. Then, taking the above-stated advantages into consideration, the form of corrugations on the end face of the web roll is selected according to purposes.

If the corrugations on the end face of the web roll 17 is formed like a sine wave as shown in Fig. 4(A), a displacement x of the web 10 in the width direction during

the traversing is given by

$$x = W \sin \frac{2\pi}{P} \left(\sqrt{\frac{V_L \cdot t \cdot h}{\pi}} + R_C - R_0 \right),$$

where R_C is a radius of the core 16, R_0 is a radius of the web roll 17 at the start of the traversing, P is a traverse pitch, W is a half amplitude of the traversing, V_L is transfer speed of the web 10, h is a thickness of the web 10, and t is time.

As described above, according to the method and apparatus for winding the web in this embodiment, the web 10 is traversed in the width direction of the web 10 and is wound on the core 16 into the web roll 17. To wind the web 10 which is knurled at both edges or one edge thereof into the web roll 17, the thick parts and thin parts of the web 10 are alternately layered, so that the web 10 can be wound under an even pressure and the web roll 17 can have good form. Moreover, the winding pressure is prevented from concentrating at both edges of the web which has been wound in the web roll, so that the web edges can be prevented from being stretched or folded. Furthermore, since each end face of the web roll 17 has the corrugations of predetermined form, it is possible to prevent the web from slipping on the web roll and make the transportation of the web roll more convenient.

In this embodiment, the web 10 is wound on the core 16 while the web 10 is traversed in the width direction of the web 10 so that each end face of the web roll 17 can have corrugations of predetermined form. During winding of the web 10, the core 16 may be traversed, instead of or together with the web 10, in the axial direction of the core 16, which is parallel with the width direction of the web 10, so that each end face of the web roll 17 can have corrugations of predetermined form.

A description will be given of the second embodiment for the web winding apparatus according to the present invention.

The web winding apparatus in the first embodiment may be applied to wind a various kinds of web other than the web which is coated with the photosensitive material. If the types of the web are changed in the winding apparatus, the guide rollers 12, which transfer the web 10, must be exchanged according to the characteristics of the web.

Conventionally, an operator interchanges the guide rollers by hand, but in this embodiment, there is provided a guide roller interchange device which is able to automatically interchange guide rollers.

Figs. 5, 6 and 7 are a front view, a plan view and a side view, respectively, illustrating the construction of the guide roller interchange device 30. As shown in the drawings, the guide roller interchange device 30 interchanges the guide rollers by means of a biaxial turret. A description will be given of the construction of the guide roller interchange device 30.

Bearing units 34 are arranged at the top of a pair of supports 32 standing on a base plate (not shown). A rotary shaft 36 is rotatably supported by the bearing units 34.

A pair of turret plates 38 are secured to the rotary shaft 36 at a predetermined interval. Bearings 40 are formed at both ends of the turret plates 38, and a pair of guide rollers 12A, 12B are detachably supported by the bearings 40.

An output shaft of a rotary actuator 44 connects to one end of the rotary shaft 36 via a joint 42, and the rotary shaft 36 is rotated by a rotational force from the rotary actuator 44.

On rotation of the rotary shaft 36, the turret plates 38 secured to the rotary shaft 36 rotate, and thereby, the pair of guide rollers 12A, 12B rotate about the rotary shaft 36.

Thus, if the rotary shaft 36 is rotated by 180°, the guide rollers 12A, 12B are interchanged. That is, the guide roller which is used for transferring the web at present, the upper guide roller for example, can be interchanged with the other by rotating the rotary shaft 36.

A mechanism described below determines which guide roller is used at present. As shown in Figs. 6 and 7, an indicator 46 is secured to the output shaft of the rotary actuator 44, and a pair of photoelectric sensors 48A, 48B are arranged so as to face one another across the indicator 46. Since the indicator 46 is secured to the output shaft of the rotary actuator 44, the indicator 46 rotates by the same degrees as the output shaft. The indicator 46 is set so as to face the photoelectric sensor 48A when the guide roller 12A is at the position for transferring the web, and face the photoelectric sensor 48B when the guide roller 12B is at the position for transferring the web. Thus, by determining which photoelectric sensor detects the indicator 46, it is possible to determine which guide roller is being used.

A description will be given of the operation of the guide roller interchange device which is constructed in the above-mentioned manner.

The guide rollers 12A, 12B which are suitable for transferring the web of two types, respectively, are mounted on the turret plates 38 of the interchange device 30. One guide roller, which is suitable for transferring the web 10, is selected for use.

If the guide roller 12A is selected, the guide roller 12A is positioned at the upper side. Then, if the types of the web 10 are changed and it becomes necessary to interchange the guide roller 12A with the other guide roller 12B, the rotary actuator 44 is driven to rotate the rotary shaft 36 by 180°. Thereby, the positions of the guide rollers 12A and 12B are switched so that the guide rollers can be interchanged.

By applying the guide roller interchange device 30 in this embodiment to the web winding apparatus in the first embodiment, the suitable guide roller can be quickly selected according to the type of the web.

In this embodiment, the guide rollers of the different types are interchanged according to the types of the web, but there is a method described below. The guide rollers of the same type are mounted on the turret plates 38, so that the guide roller can be quickly exchanged when a trouble occurs.

In this embodiment, two guide rollers is mounted on the turret plates 38; however, more guide rollers may be mounted on the turret plates 38 so that more kinds of web can be transferred.

In this embodiment, there was no explanation about the kinds of guide rollers. Examples of the guide roller are: 1) a guide roller which has a flat surface, 2) a guide roller which has a groove on the surface thereof, 3) a guide roller made of rubber, and 4) a guide roller of high rigidity. A suitable guide roller is selected from the guide rollers according to a type of the web.

If the web is slippery, the guide roller provided with the groove or the guide roller made of rubber is preferably used. If the web is not slippery (which results in the wrinkles), the guide roller which has a flat surface is preferably used. If the web is thick, the guide roller which has a flat surface is preferably used, and if the web is thin, the guide roller of high rigidity is preferably used.

As set forth hereinabove, according to the present invention, the web is wound into the web roll while being traversed so that each end face of the web roll of the wound web has corrugations of predetermined form. Thereby, the web can be prevented from being stretched and folded at its edges during winding. The web can be prevented from slipping on the web roll. The web roll can have good form and be suitable for transportation.

It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the invention is to cover all modifications, alternate constructions and equivalents falling within the spirit and scope of the invention as expressed in the appended claims.

Claims

1. A web winding method for winding web (10) on a core (16) into a roll (17) comprising:

   winding said web (10) on said core (16) while traversing at least one of said web (10) and said core (16) at a predetermined cycle and a predetermined amplitude in a width direction of said web (10) so that each of end faces of said roll (17) can have corrugations of predetermined form.

2. The web winding method as defined in claim 1, wherein:

   the cycle and amplitude for traversing said at least one of said web (10) and said core (16) are determined so that each of said end faces of said roll (17) can have the corrugations of sine wave form.

3. The web winding method as defined in claim 1, wherein:

   the cycle and amplitude for traversing said at least one of said web (10) and said core (16) are determined so that each of said end faces of said roll (17) can have the corrugations of sawtooth form.

4. The web winding method as defined in claim 1, wherein:

   the cycle and amplitude for traversing said at least one of said web (10) and said core (16) are determined so that each of said end faces of said roll (17) can have the corrugations of which highest and lowest parts are flat.

5. The web winding method as defined in claim 1, wherein:

   said web (10) is coated with a photosensitive material; and
   when said web (10) is between 30 μm and 300 μm in thickness, the cycle and amplitude for traversing said at least one of said web (10) and said core (16) are determined so that a cycle (B) of the corrugations on each of said end faces of said roll (17) is between 5 mm and 200 mm and an amplitude (A) thereof is between 1 mm and 20 mm.

6. A web winding apparatus for winding web (10) on a core (16) into a roll (17) comprising:

   a first guide roller (12, 12A) for transferring said web (10);
   width direction moving means (26) for traversing at least one of said web (10) and said core (16) in a width direction of said web (10); and
   control means (28) for controlling said width direction moving means (26) to traverse said at least one of said web (10) and said core (16) at a predetermined cycle and a predetermined amplitude so that each of end faces of said roll (17) can have corrugations of predetermined form.

7. The web winding apparatus as defined in claim 6, further comprising:

   a second guide roller (12B) which is alternative to said first guide roller (12A); and

a turret plate (38) for supporting said first and second guide rollers (12A, 12B) and for rotating to select one from said first and second guide rollers (12A, 12B).

FIG. 1

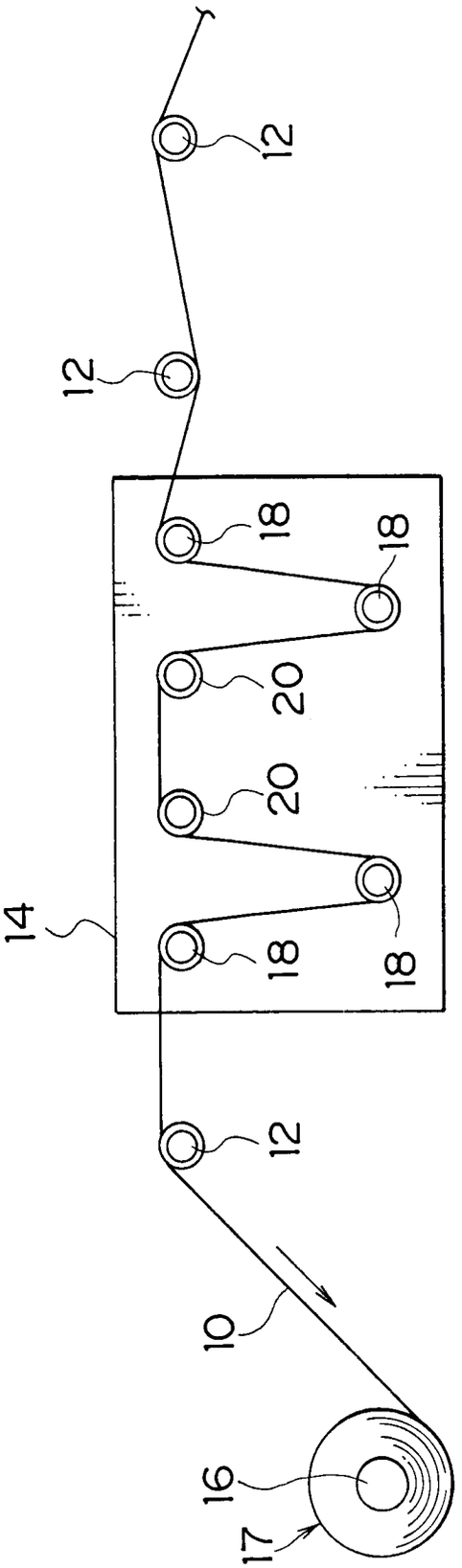

FIG. 2

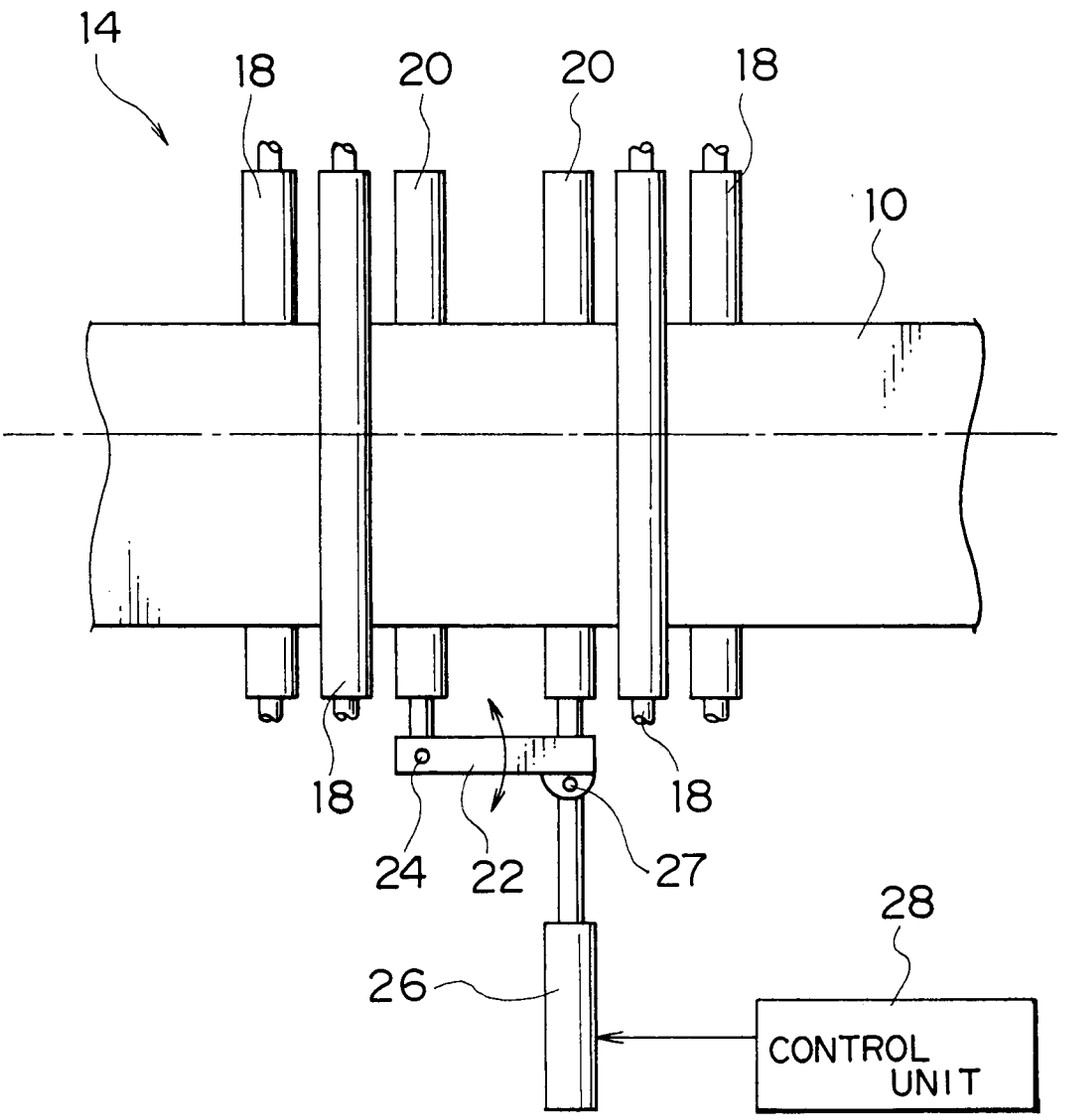

FIG. 3

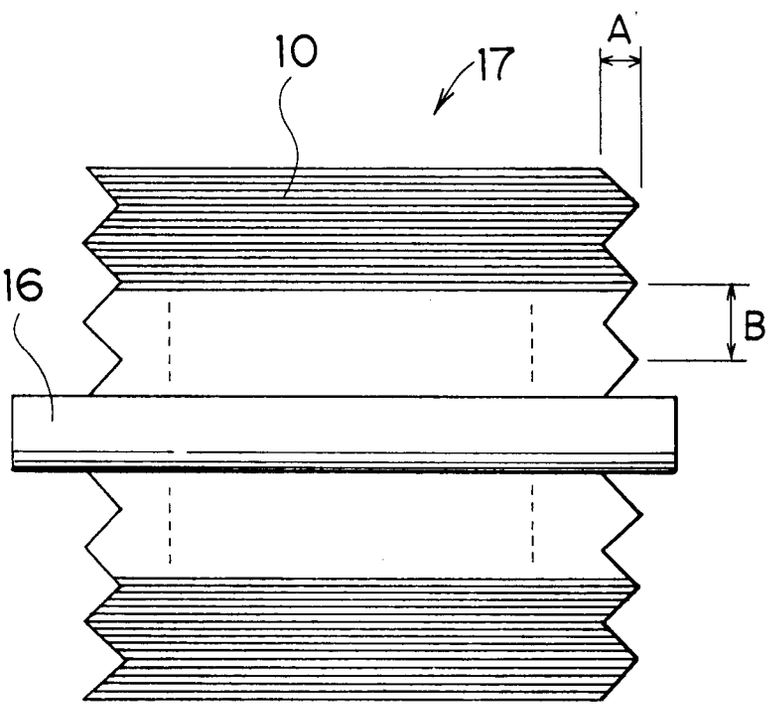

FIG. 4 (A)

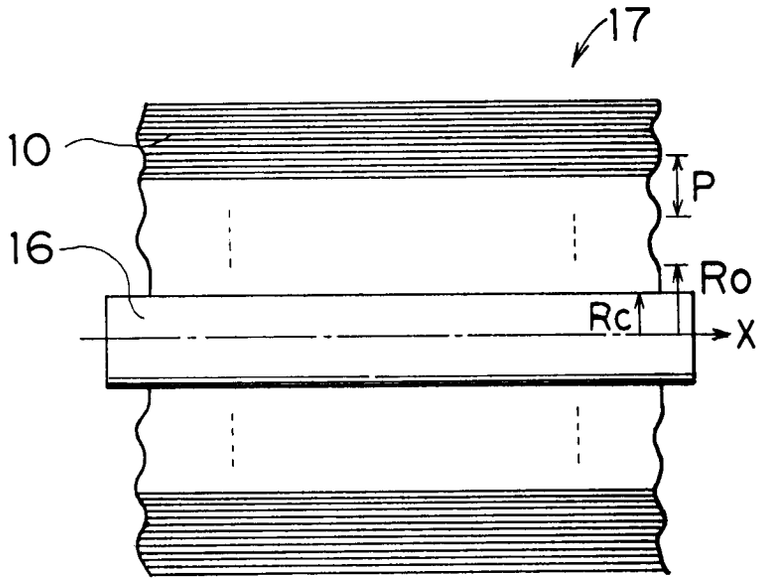

FIG. 4 (B)

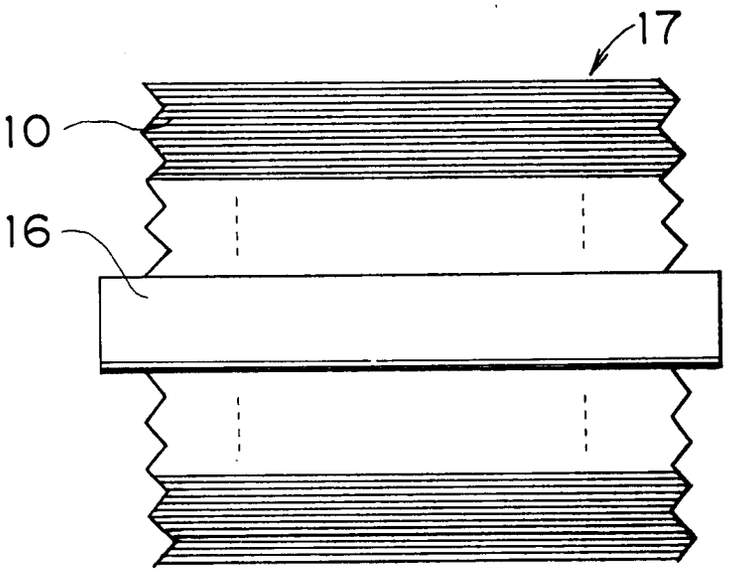

FIG. 4 (C)

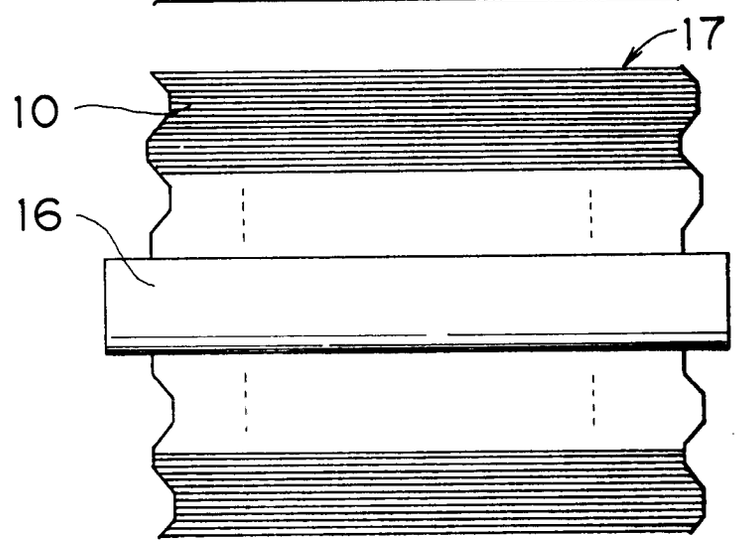

FIG. 5

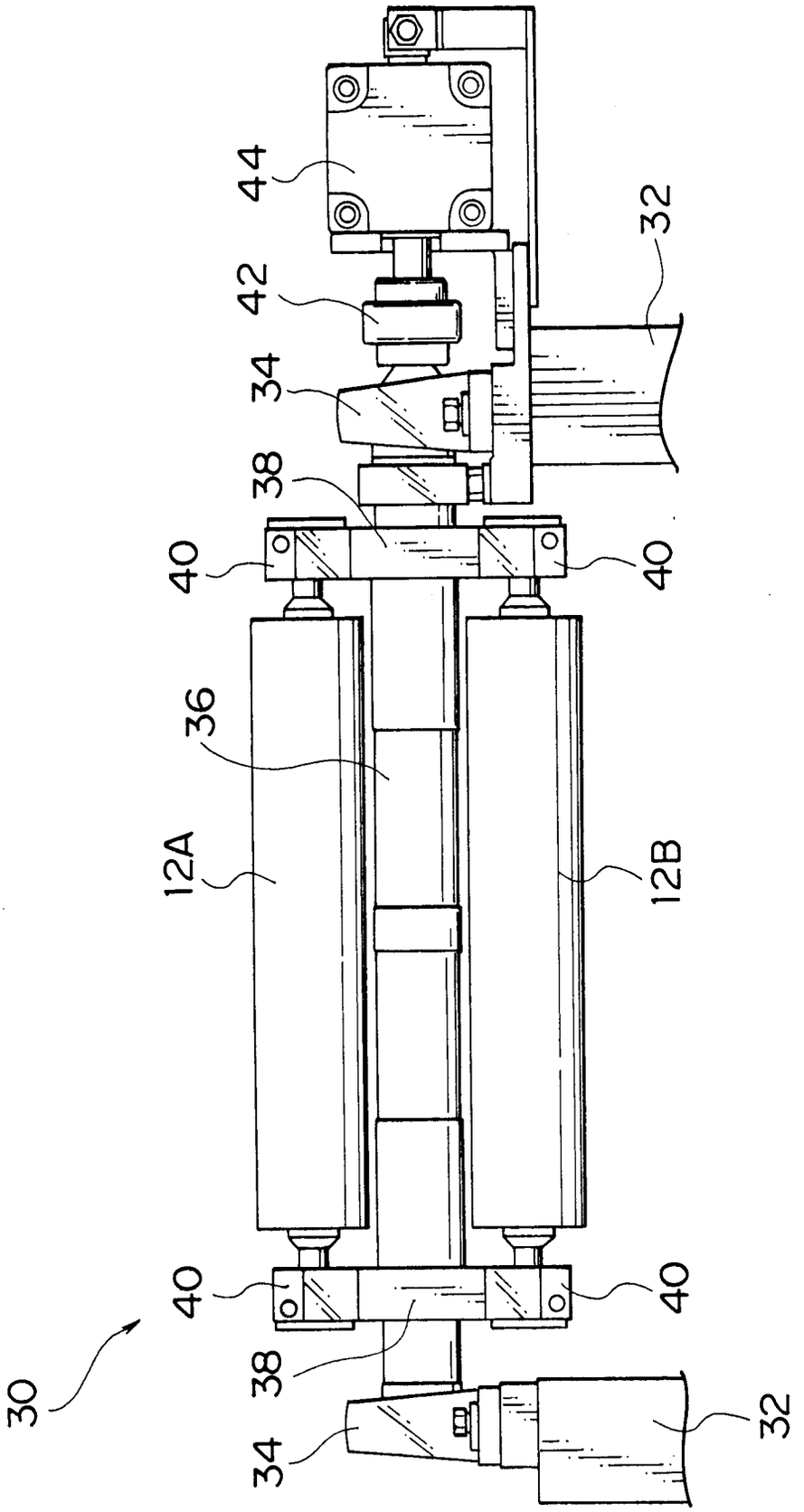

FIG. 6

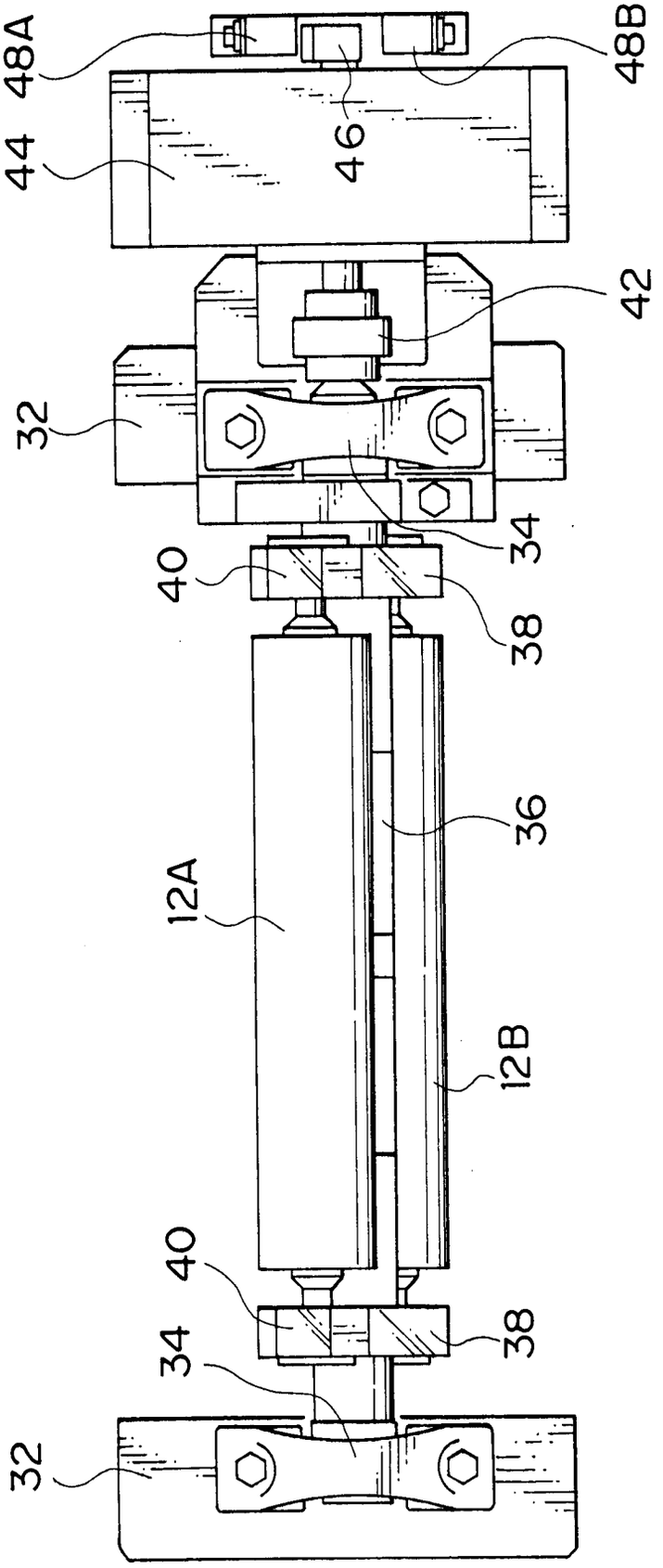

FIG. 7