United States Patent

Otani

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[54] **APPARATUS FOR CONTINUOUSLY WINDING UP A LINEAR PRODUCT SUCH AS WIRE**

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[52] **U.S. Cl.** .....**242/25 A**

[51] **Int. Cl.** **B65h 54/02**

[58] **Field of Search** .....242/25, 18 A, 18 EW, 18 PW

[56] **References Cited**

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Assistant Examiner—Milton Gerstein
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[57] **ABSTRACT**

A continuous wire take-up apparatus having pair of rockable reel supporting frames. A disc is mounted on each pair of reel supporting frames adjacent one end of the reel for rotation therewith. One of the pairs of the frames is rocked down when the associated reel becomes substantially full of the wire. At the same time, a wire guiding sheave is moved axially of the reels to the above of the discs. A wire shifting rod is moved between the reels axially thereof to shift the wire beyond the discs. Claws project from the discs to engage the thus shifted wire and arrest it on the discs. The rotation of the discs cuts the wire between the discs. The cut end of the wire arrested on the disc for the empty reel causes a further length of the wire to be wound up thereon.

7 Claims, 5 Drawing Figures

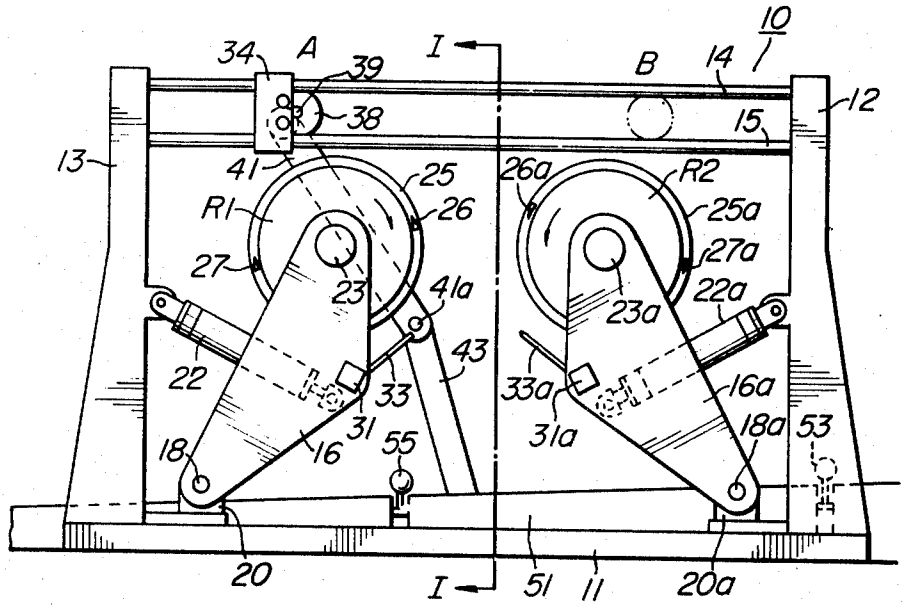


FIG. 1

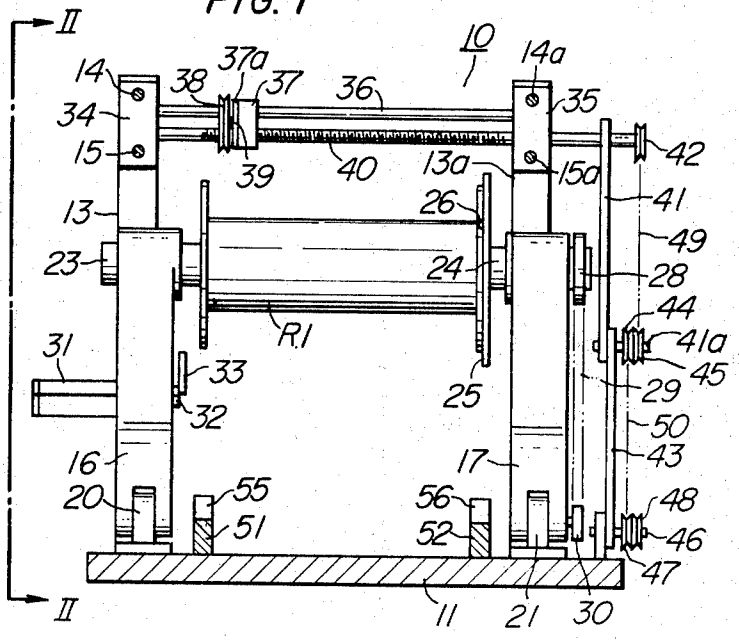

II
10
14
14a
37a
38
37
36
34
35
15
39
40
13a
15a
42
41
13
26
49
23
24
28
44
R1
41a
31
33
45
25
29
32
50
16
17
43
20
55
56
48
51
52
46
47
11
21
30
II

FIG. 2

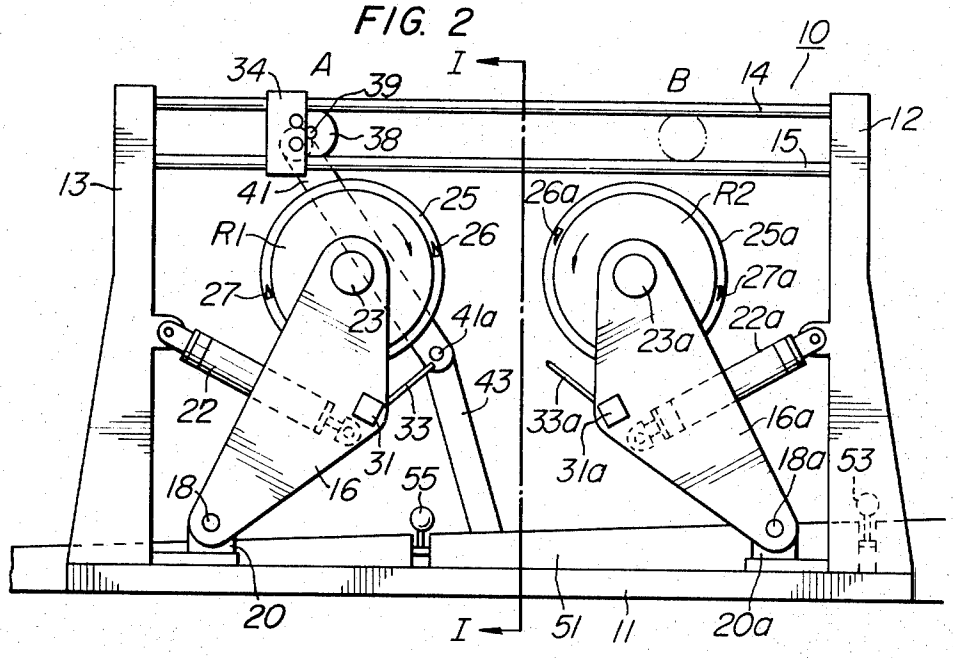

10
34
A
39
I
B
14
12
38
15
13
41
25
26a
R2
R1
26
25a
27
27a
23
41a
22a
23a
22
43
33a
16a
33
31
31a
18a
53
18
16
55
20
I
51
11
20a

FIG. 3

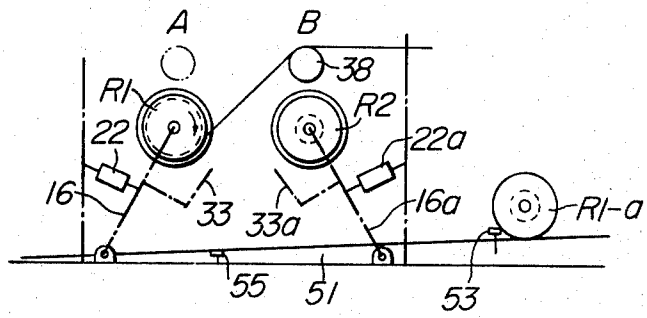


FIG. 4

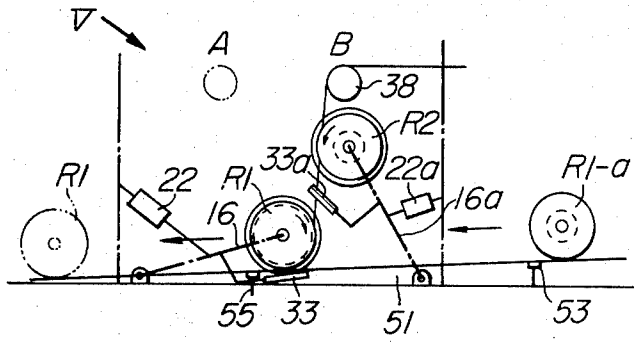
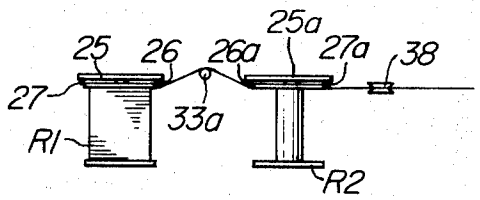


FIG. 5



APPARATUS FOR CONTINUOUSLY WINDING UP A LINEAR PRODUCT SUCH AS WIRE

FIELD OF THE INVENTION

The present invention relates generally to an apparatus for continuously winding up a linear product such as wire and, particularly, to an apparatus of this kind and in which, when the product has been wound up on a reel substantially to its full capacity, the product is then automatically transferred from the full reel to another empty one and is continuously taken up thereon.

In the apparatus of this kind, various types of automatic linear product transfer mechanisms have heretofore been proposed. However, none of the conventional transfer mechanisms performs satisfactory and smooth transferring operation and this is especially true when the apparatus is operated to wind up a linear product at higher speed. With the conventional transfer mechanism, furthermore, the apparatus designed for use with large-sized take-up reels is inevitably required to have a large-sized construction in its entirety so as to be adapted for the large reels.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved apparatus for continuously winding up a linear product which can eliminate the problems and drawbacks mentioned in the above.

It is another object of the present invention to provide an apparatus of the class mentioned in the above and which assures reliable and smooth operation in transferring the linear product from a full reel to another empty one.

It is a further object of the present invention to provide an apparatus of the class mentioned in the above and which is designed to be adapted for take-up reels of relatively larger size as compared with the size of the apparatus in its entirety.

These objects are achieved by the construction of an apparatus of the present invention which comprises pairs of frame members pivotally mounted on a base, said pairs of frame members being adapted to detachably and rotatably support thereon take-up reels in parallel relationship to one another, motor means for rotating the reels on said pairs of frame members in opposite directions, power means for rocking said pairs of frame members about pivotal axes thereof, a disc member mounted on each pair of said frame members adjacent one end of the reel thereon for rotation therewith, means for guiding said linear product from its delivery position to one of the reels on said pairs of frame members, said power means being operable to rock down the pair of said frame members associated with said one reel when it has taken up said linear product almost to its full capacity to bring the run of said product into contact with the periphery of the other empty reel, said guiding means being movable in a horizontal plane above said reels in directions parallel and perpendicular, respectively, to the axes of rotation of the reels, means movable between said reels axially thereof for shifting the part of said linear product axially of said reels beyond said discs when said one reel has take up said product substantially to its full capacity, said part of said linear product extending between said reels, and at least one claw member on each of said discs adjacent the periphery thereof, said claw members being adapted to engage the thus shifted part of said linear product and arrest it on said discs to cause said product to be cut between said claw members by the rotation of said discs whereby the cut end of said product arrested on the disc associated with said empty reel enables a further continuous length of said linear product to be continuously wound up on said empty reel.

The above and other objects and features of the present invention will become more apparent from the following description of an embodiment of the invention with reference to the accompanying drawings.

DESCRIPTION OF DRAWINGS

FIG. **1** is a front elevation of the wire take-up apparatus according to an embodiment of the present invention;

FIG. **2** is a side elevation of the apparatus shown in FIG. 1;

FIG. **3** schematically illustrates in side view the wire take-up operation of the apparatus of the present invention;

FIG. **4** schematically illustrates in side view the apparatus in a position in which the wire has been wound up on one reel almost to its full capacity; and

FIG. **5** is a schematic view, as viewed substantially in a direction indicated by an arrow V, of the arrangement of reels, associated disc members, a wire shifting rod and wire guiding traverse sheave when the wire has been completely wound up on the one reel and is going to be transferred to another empty reel.

DESCRIPTION OF A PREFERRED EMBODIMENT

The present invention will be described hereunder in detail with reference to an illustrated embodiment of the invention which is designed to be suitable for winding up a continuous length of wire. It is, however, to be noted that the invention is not limited to winding up of wire only but is applicable to other similar linear products.

Referring first to FIGS. **1** and **2** of the drawings, there is illustrated an embodiment of the linear product take-up apparatus of the invention which is generally indicated at **10**. The apparatus **10** has a base **11**, two pairs of upright frames or posts **12** and **12***a* (post **12***a* not appearing in the drawings) and **13** and **13***a* extending upwardly from the base **11** substantially at the four corners thereof. A pair of horizontal bars or shafts **14** and **15** of circular cross-section extend between and are fixed at their opposite ends to the posts **12** and **13** adjacent the top ends thereof. Similarly, a pair of horizontal shafts **14***a* and **15***a* extend between and are fixed at their opposite ends to the posts **12***a* and **13***a* adjacent the top ends thereof.

A pair of generally triangular frame members **16** and **17** are pivotally mounted at one apexes or bottom ends on the base **11** adjacent the bottom ends of the posts **13** and **13***a* by means of axles **18** and **18**a and brackets **20** and **21** on he base **11**. One of the frame members **16** is operatively connected substantially at the center of the length thereof to the corresponding upright post **13** substantially at the center of the height thereof by means of a piston and cylinder assembly **22**, as shown in FIG. **2**, which is adapted to be pneumatically or

hydraulically actuated to pivotally move or rock the frame member **16** for the purpose which will be come apparent later. If necessary, the other frame member **17** may also be similarly actuated by a similar fluid-actuated piston and cylinder assembly (not shown) operatively connecting the member **17** with the corresponding upright post **13***a*.

The pair of frame members **16** and **17** are adapted to support thereon a wire take-up reel indicated by **R1**. For this purpose, the member **16** carries at the upper apex a relatively shorter axle or shaft **23** which may be slidably retracted outwardly, when required, by any conventional power means such as conventional fluid-actuated cylinder (now shown). The other frame member **17** has an axle or shaft **24** rotatably extending through the upper apex. The shaft **24** has a disc member **25** rigidly mounted thereon adjacent the inner end. The disc member is provided with inwardly projecting claws **26** and **27** adjacent the outer periphery of the disc member. The shafts **23** and **24** are adapted to support a wire take-up reel **R1** on the inner ends of the shafts in such a manner that the flange on one end of the reel is in face to face engagement with the disc member **25** so as to be driven or rotated therewith.

For this purpose, the shaft **24** has a pulley **28** rigidly mounted thereon adjacent the outer end. The pulley **28** is operatively connected by a belt **29** with a second pulley **30** disposed co-axially with the pivotal axis of the frame member **17**. The pulley **30** is operatively connected to a motor means (not shown) by any conventional torque transmitting means such as belt or chain. It will be appreciated that, since the second pulley **30** is mounted in coaxial relationship with the axis of rocking motion of the frame member **17**, the torque of the not shown motor means is advantageously transmitted through the belt **29** and the first pulley **28** to the shaft **24** and thus to the reel **R1** in whichever position of the path of the rocking motion the frame member **17** may be.

The triangular frame member **16** has another fluid-actuated piston and cylinder assembly **31** mounted thereon adjacent the remaining or inner apex. The fluid-actuated assembly **31** has a piston rod **32** supporting at the free end an inwardly and upwardly extending rod **33** for the purpose which will also become apparent later.

Another pair of generally triangular frame members **16***a* and **17***a* (member **17***a* not appearing in the drawings) are provided adjacent the other upright posts **12** and **12***a* in a manner similar to that in which the reel supporting frame members **16** and **17** are provided. The frame members **16***a* and **17***a* are also adapted to support thereon another reel, represented by **R2**, and thus are associated with elements similar to those associated with with elements similar to those associated with frame members **16** and **7**. Therefore, no further description will be required in connection with the frame members **16***a* and **17***a* with the exception that the elements for the members **16***a* and **17***a* similar or corresponding to those for the members **16** and **17** are represented by similar reference numerals and followed by a character "*a*".

Blocks **34** and **35** are slidably mounted on respective pairs of horizontal shafts **14** and **15** and **14***a* and **15***a*. A transverse shaft **36** extends between and are fixedly secured at the opposite ends to the blocks **34** and **35**, respectively. Another block or slide member **37** having a bracket **37***a* is slidably mounted on the transverse shaft **36**. The slide member has a sheave member **38** rotatably mounted on a stud **39** on the bracket **37***a*. The sheave member **38** is adapted to guide the wire form its delivery source to a working reel so that the wire is wound on the reel in good order. The slide member **37** has formed therein an internally threaded through hole (not shown) through which extends a second transverse shaft **40** having formed thereon turns of external screw threads which engage the internal screw threads in the slide member **37**. The threaded shaft **40** is rotatably received at one end by the block **34** and extends rotatably at the other end through and beyond the other block **35**.

The said other end of the threaded shaft **40** loosely extends through one end of a link **41** disposed outwardly of the frame member **17**. A pulley **42** is rigidly mounted on the end of the shaft **40** outwardly of the link **41**. The latter is hinged at the other end to a second link **43** by means of a hinge pin **41***a* on which rotatably mounted are pulleys **44** and **45** which are connected together for unitary rotation. The second link **43** is pivotally mounted at the other or lower end on a stationary shaft **46** on which rotatably mounted are pulleys **47** and **48** which are also connected together into a unitary structure. The last pulley **48** is suitably operatively connected to a motor means (not shown) which may either be one of the motors for rotating the reels, or be a separately provided motor. A belt **49** drivingly connects the pulley **45** with the pulley **42** while another belt **50** drivingly connects the pulley **47** to the pulley **44**.

Means (not shown) are provided to move the blocks **34** and **35** and thus the sheave **38** from the solid line position (A) in FIG. **2** to a broken line position (B) in a direction substantially perpendicular to the axes of rotation of the reels **R1** and **R2** substantially in a plane defined between the two pairs of the horizontal shafts **14** and **15** and **14***a* and **15***a* . These means may be any conventional drive mechanism such as sprocket wheels and a chain running around the sprockets, one of the sprockets being driven by a motor and the chain being connected or secured at upper or lower run to one of the blocks **34** and **35**. Alternatively, the mentioned means may be a fluid-actuated cylinder having its piston rod secured to one of the blocks **34** and **35**.

The upper end of the link **41** is loosely mounted on the outer end of the externally threaded transverse shaft **40**, as described in the above, so that the link **41** will follow the movement of the blocks **34** and **35**. This movement of the link **41** causes the second link **43** to be swung or oscillated about the stationary shaft **46** while the drive connection between the externally threaded shaft **40** and the motor means therefor is maintained by means of the link connection and the associated pulleys and belts. Thus, it will be appreciated that the torque of the motor means is transmitted through the pulleys and belts to the externally threaded transverse shaft **40** in whichever position the blocks **34** and **35** may be with respect to the axis of rotation of the stationary pulleys **47** and **48**.

A pair of rails **51** and **52** are provided on the base **11** and extend transversely of the axes of rotation of the

reels R1 and R2 between the opposite frame members of each pair of reel supporting frame structure. These rails are designed to guide wire take-up reels therealong in such a manner that an empty reel is rolled on the rails 51 and 52 into the apparatus and a full reel is rolled out of the apparatus. For this purpose, the rails 51 and 52 are slightly sloped down from the empty reel rolling-in position toward the full reel rolling-out position. A pair of stops 53 are provided in the rails 51 and 52, respectively, at a position upstream of the pairs of reel supporting frames. Similarly, another pair of stops 55 and 56 are provided in the rails 51 and 52 in such a position as to hold a full reel dismounted down onto the rails from either pair of reel supporting frame members. Both pairs of stops 53 and 54 and 55 and 56 are designed to be retracted down below the surfaces of the rails by any conventional means so that empty and full reels may be free, when required, to roll down along the rails.

Now, a description will be made with respect to the operation of the apparatus in reference to FIGS. 3 to 5.

FIG. 3 schematically illustrates the apparatus in a position in which the wire guiding sheave 38 is in the position B and is guiding the wire to the reel R1 mounted on the pair of frame members 16 and 17. Another empty reel R2 is prepared on he other pair of frame members 16*a* and 17*a*. Still another or next empty reel R1-*a* is prepared on the rails 51 and 52 and stopped by the stops 53 and 54.

When the wire is wound up on the reel R1 almost to its full capacity, the reel R2 is started its rotation and the peripheral speed thereof is adjusted so as to be substantially the same as the linear speed of the wire being taken up on the reel R1. At the same time, the piston and cylinder assembly 22 is actuated to move or rock the reel supporting frame members 16 and 17 down to a position shown in FIG. 4 so that the running wire is brought into contact with the periphery of the wire take-up drum of the reel R2, as will be seen in FIG. 4. At the time the reel R1 has taken up the wire thereon to its full capacity, he wire guiding sheave 38 is rapidly moved by the rotation of the externally threaded shaft 40 to a position, shown in FIG. 5, which is axially beyond the disc 25*a*. The sheave 38 is maintained at this position for a while. Simultaneously, the piston and cylinder assembly 31*a* is actuated to move the associated rod 33*a* axially of the reels R1 and R2 beyond the discs 25 and 25*a* so that the part of the wire between the discs is engaged by the claws 26 and 26*a*, as seen in FIG. 5, and arrested on the discs. The continuous rotation of the reels and the discs is sufficient to cut the wire therebetween. The cut end of the wire arrested on the disc 25*a* causes a further continuous length of the wire to be taken up on the reel R2. In other words, the wire is thus automatically transferred from the full reel R1 to the empty one R2. The wire guiding sheave 38 is then moved to the position A and serves in this position to guide the wire to the reel R2 until it takes up the wire almost to its full capacity.

On the other hand, the full reel R1 has stopped its rotation and is then removed off the pair of reel supporting frame members 16 and 17 down onto the rails 51 and 52 by retracting the shaft 23 outwardly. The thus removed full reel is rolled down off the apparatus 10 as shown in FIG. 4 by broken line. Then, the stops 53 and 54 are retracted down and another empty reel R1-*a* , which has been prepared on the rails, are rolled down until it is reached by the stops 55 and 56. The new reel R1-*a* is then mounted on the pair of frame members 16 and 17 which are then rocked upwardly to their normal position shown in FIG. 2 by the piston and cylinder assembly 22. When the reel R2 has taken up the wire thereon substantially to its full capacity, the piston and cylinder assembly 22*a* is actuated to rock down the reel supporting frame members 16*a* and 17*a* and the apparatus 10 operates in cyclical manner in a similar fashion.

In the above-described and illustrated embodiment of the present invention, the wire shifting rods 33 and 33*a* are mounted on the piston and cylinder assemblies 31 and 31*a* which are mounted on the respective pairs of reel supporting frame members 16 and 17 and 16*a* and 17*a*. The wire shifting rods 33 and 33*a*, however, may be disposed at any position which may enable these rods to shift the wire axially of the reels beyond one ends thereof.

It is particularly to be noted that when one of the pairs of reel supporting frame members is rocked down together with a substantially full reel thereon, the wire being still taken up on the full reel is brought into contact with the wire take-up drum of another empty reel and is advanced along a substantially vertical path as will be seen in FIG. 4. This makes it possible for a single rod, which is associated with the empty reel, to be brought into contact with the portion of the wire extending between the opposite wire take-up drums and bias or shift the wire portion axially beyond one ends of the reels whereby the wire is engaged and arrested by the claws on the discs at the said one ends of the reels. It is also pointed out that the sloped rails 51 and 52 and the stops 53 and 54 and 55 and 56 assure easy mounting and dismounting of reels on and off the reel supporting frame members.

What is claimed is:

1. An apparatus for continuously winding up a linear product comprising a housing, a pair of frame members each pivotally mounted in said housing on parallel pivotal axes, a take-up reel for each of said frame members, said reels being detachably and rotatably supported in a first position in side by side parallel relationship in substantially the same plane on said frame members, motor means for rotating each of said reels in opposite directions, power means for rocking each of said frame members about said pivotal axes toward and away from each other to a second position whereby one reel is in a plane below that of the other, a disc member mounted on each of said frame members adjacent one end of the reel thereon for rotation therewith, a source means for said linear product, means for guiding said linear product, means for guiding said linear product from said source means alternately to said reels, said linear product running substantially tangential to each of said reels when one of said frame members is in the second position, said guiding means being movable in a horizontal plane above said reel in directions parallel and perpendicular, respectively, to the axes of rotation of the reels, means movable between said reel axially thereof for shifting said linear product axially of said reels beyond said discs, and at least one claw member on the periphery of each of said disc members, said

claw member being adapted to engage and cut said linear product and arrest it on said disc member when frame members are in said second position and when said product is shifted axially by said shifting means.

2. An apparatus as claimed in claim 1 in which said guiding means includes a pair of horizontal shaft members extending in parallel relationship to one another in a direction perpendicular to said axes of rotation of reels, a pair of block members slidably mounted on said shaft members respectively, a transverse shaft member rotatably extending through said block members, a sheave member mounted on said transverse shaft member for movement therealong, means for moving said sheave member along said transverse shaft member and means for moving said block members along said horizontal shaft members.

3. An apparatus as claimed in claim 2 in which said means for moving said sheave member include screw threads formed externally on said transverse shaft member, a slide member carrying thereon said sheave member for free rotation, said slide member having therein internal screw threads in engagement with said external screw threads on said transverse shaft member, a second motor means, and drive means operatively connecting said second motor means with said transverse shaft member.

4. An apparatus as defined in claim 3 in which said drive means include a pin member, first and second link members loosely hinged together at one end by said pin member, said first link member being pivotally mounted at the other end on said transverse shaft member, a second pin member, said second link member being loosely pivoted at the other end to said second pin member, a first pulley rigidly mounted on said transverse shaft member, a second pulley rotatably mounted on said first pin member, a first belt member drivingly interconnecting said first and second pulleys, a third pulley mounted on said first pin member and connected to said second pulley for rotation therewith, fourth and fifth pulleys connected together and rotatably mounted on said second pin member, a second belt member drivingly interconnecting said third and fourth pulleys, said fifth pulley being operatively connected to the output shaft of said second motor means.

5. An apparatus as claimed in claim 1 in which said means for shifting said linear product includes first and second fluid-actuated piston and cylinder assemblies, the first of which being mounted on one of said reel supporting frame members, and the second being mounted on the other of said reel supporting frame members, and product shifting rods connected at one end on the free ends of the piston rods of said assemblies, respectively, said product shifting rods extending inwardly and upwardly from a respective reel supporting frame member.

6. An apparatus as claimed in claim 5 in which said power means include fluid-actuated piston and cylinder assemblies operatively connected at one end to said housing respectively, said assemblies having their other ends operatively connected to said reel supporting frame members, respectively.

7. An apparatus as claimed in claim 1 further comprising a pair of rails on said base extending transversely of said axes of rotation of reels on respective reel supporting frame members, said rails being adapted for receiving thereon reels to be rolled into and out of said apparatus, said rails sloping in a direction, and first and second reel stopping means disposed in said rails, said stopping means being retractable down below the surfaces of said rails, said first stopping means being located remotely from said frame members and said second means be located adjacent to and generally beneath said frame members.

* * * * *