United States Patent

Otani et al.

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[54] **CONTINUOUS TAKE-UP APPARATUS FOR A LINEAR PRODUCT**

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[73] Assignee: **Kobe Steel, Ltd.,** Kobe-shi, Japan

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Feb. 26, 1969 Japan 44/17417

[52] **U.S. Cl.** .....**242/25 A,** 242/56 A

[51] **Int. Cl.**.....**B65h 54/00,** B65h 67/04

[58] **Field of Search**.....242/18 A, 25 A, 25 R, 56 A, 242/56 R, 58, 58.2, 58.4

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Primary Examiner—George F. Mautz

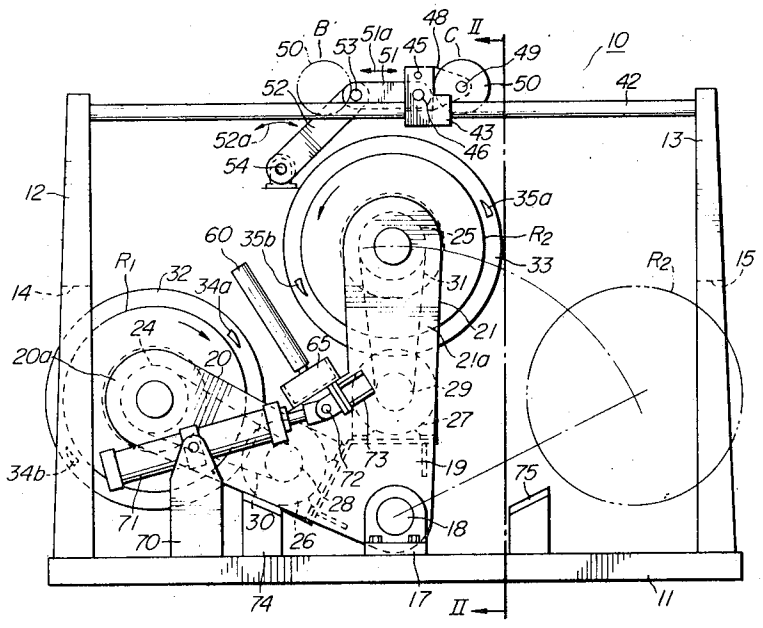
Assistant Examiner—Gregory A. Walters

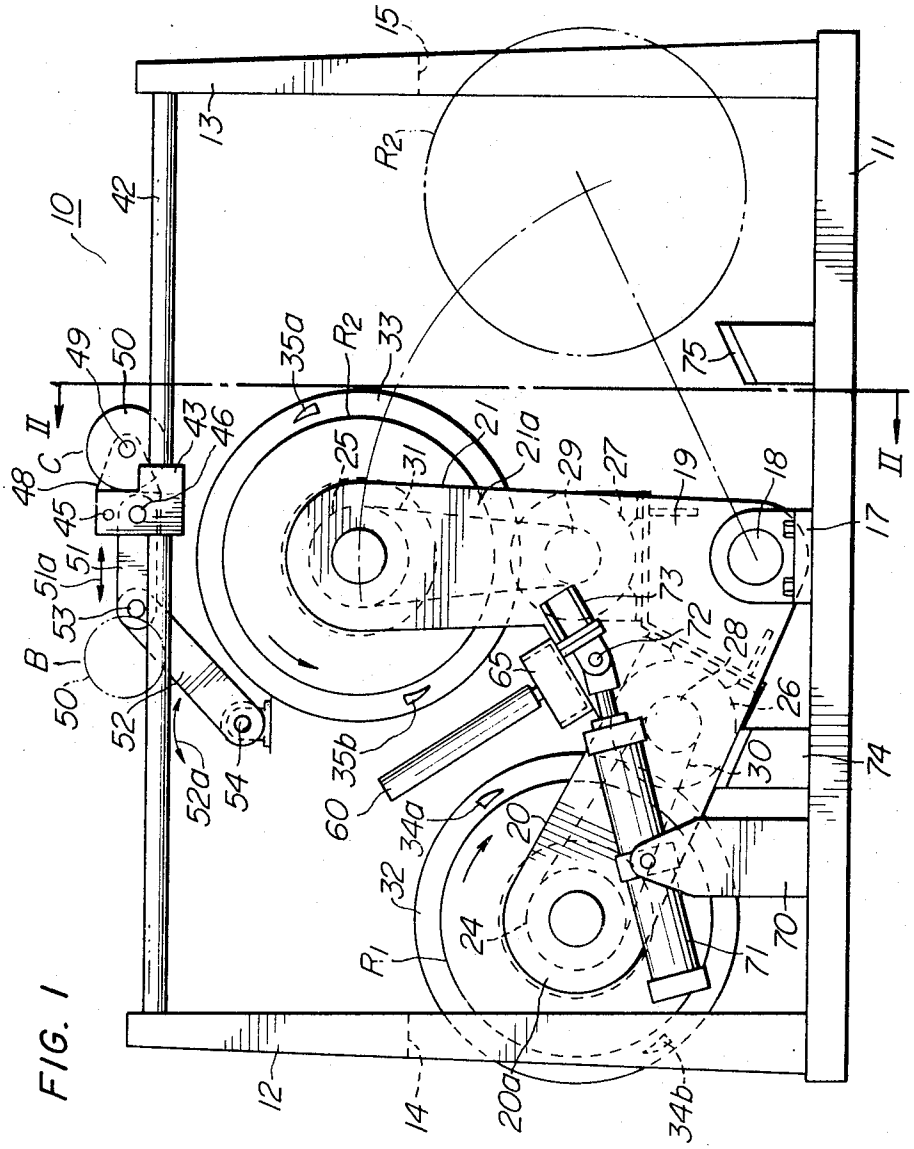
Attorney—John J. Byrne

[57] **ABSTRACT**

A wire take-up apparatus having a V-shaped frame rockable about an axis by a fluid-operated cylinder. The frame has a pair of legs on which wire take-up reels are supported for rotation about parallel axes and driven by motors. Wire guiding traverser and wire shifting rod are provided to shift the wire axially beyond one end of the reels when one reel is almost full of wire. Discs having thereon claws are provided adjacent said one ends of the reels for rotation therewith. The claws engage and arrest the shifted wire on another empty reel to change-over winding-up of wire from the full reel to the empty reel.

8 Claims, 12 Drawing Figures

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R2
11
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R2
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17
51a
51
73
72
28
B
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65
26
50
52
52a
54
35b
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74
32
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R1
71
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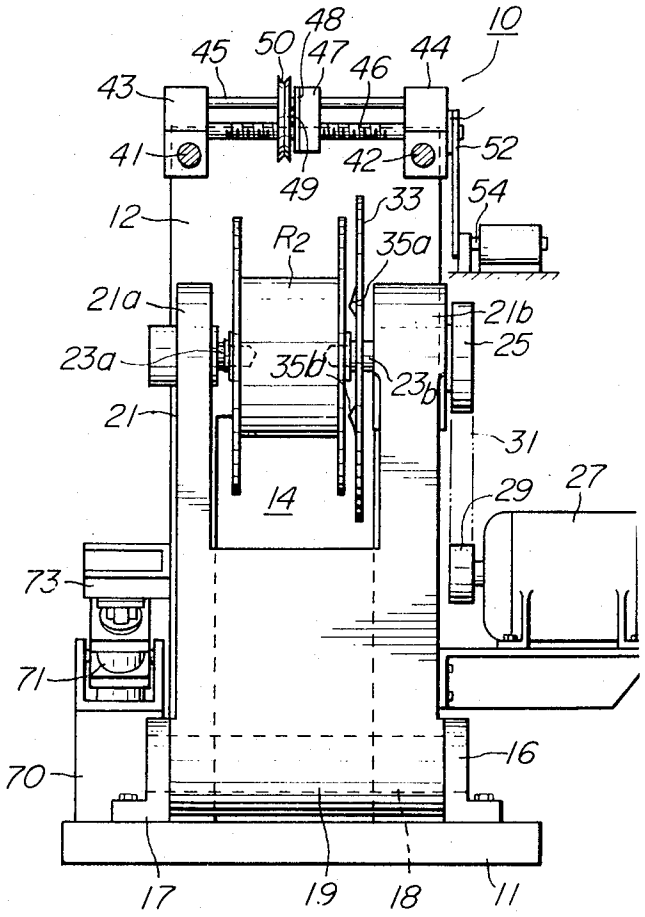
12
14
20a
34b

FIG. 1

FIG. 2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45
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R2
35a
21a
21b
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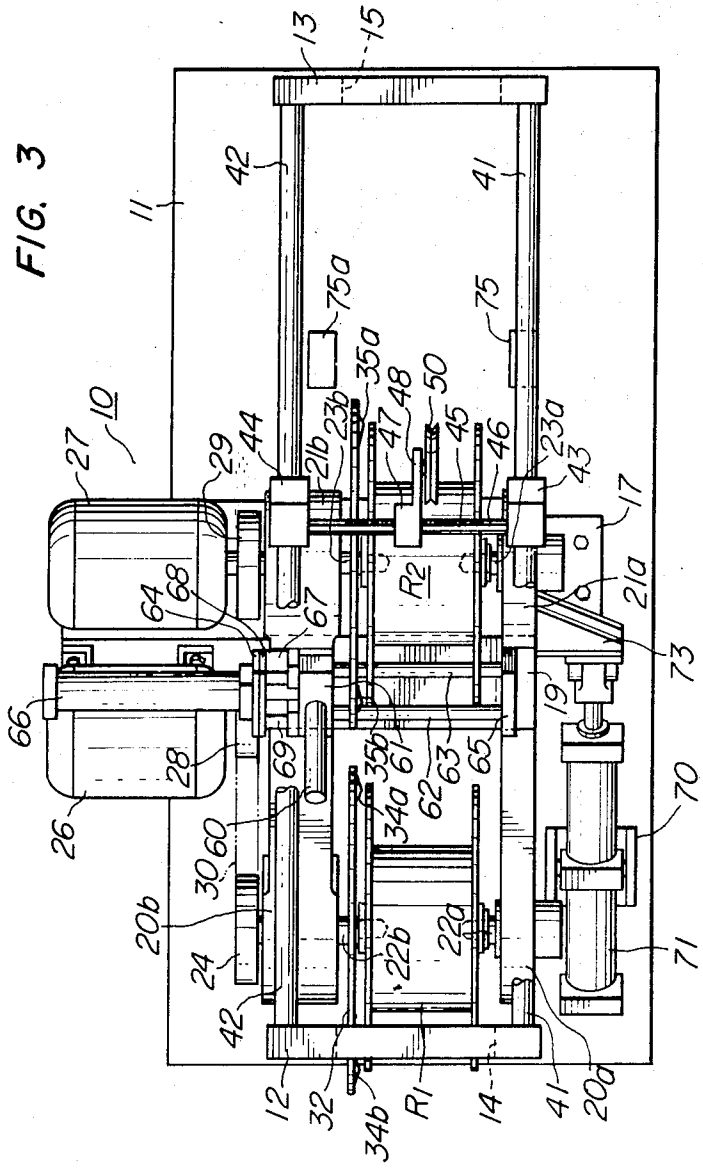
FIG. 3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41
11
75a
75
35a
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50
10
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23b
47
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23a
29
21b
43
17
R2
21a
64
68
67
73
19
66
69
35b
61
63
65
70
28
35a
62
26
60
30
20b
220
226
71
24
42
12
32
34b
R1
14
41
20a

FIG. 4

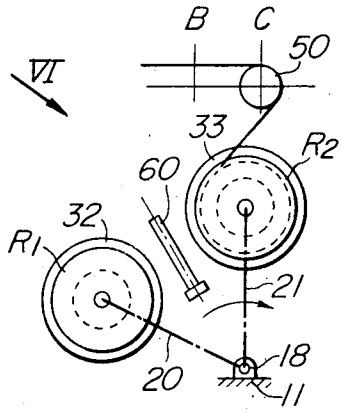


FIG. 5

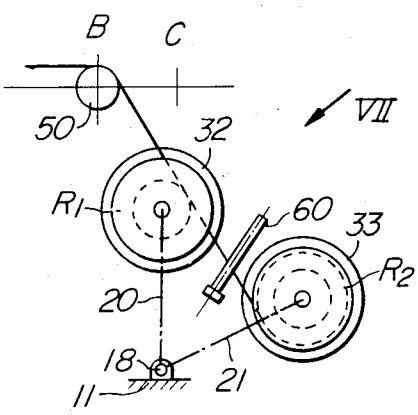


FIG. 6

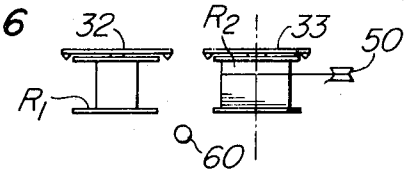


FIG. 7

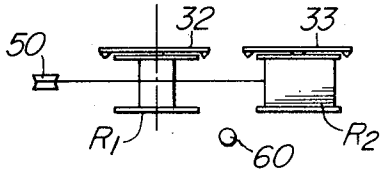


FIG. 8

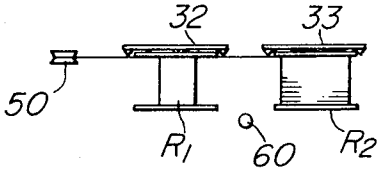


FIG. 9

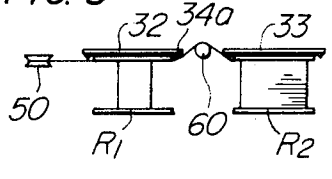


FIG. 10

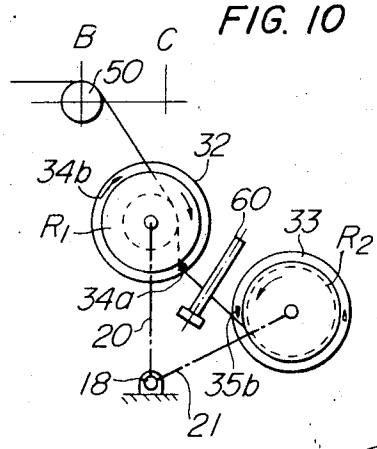


FIG. 11

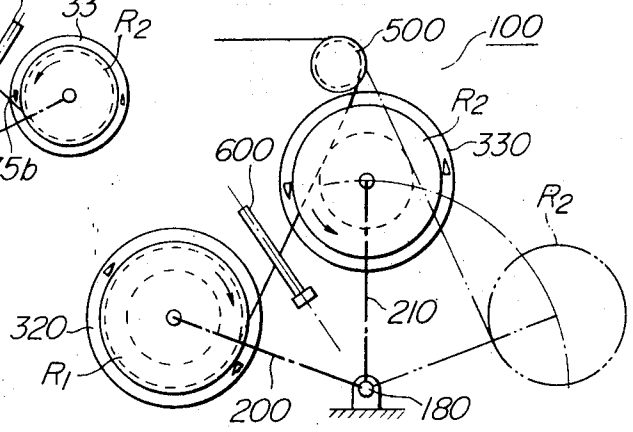
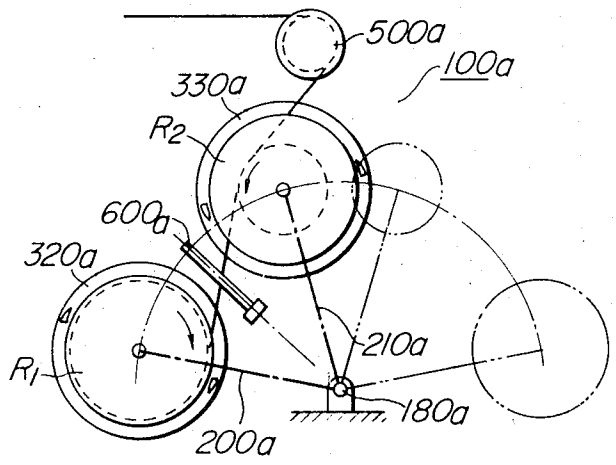


FIG. 12



CONTINUOUS TAKE-UP APPARATUS FOR A LINEAR PRODUCT

The present invention relates to a continuous take-up apparatus for a linear article such as an electrical wire and, particularly, to an improvement in the mechanism in this kind of apparatus by which mechanism the winding-up of the linear article on a reel is transferred or changed-over to another empty reel.

In a manufacturing plant for wires such as an electrical wire, a coated or covered wire is continuously taken up on reels. It is well-known in the art that, when such wire has been wound-up on a reel to a full capacity or volume of the reel, the delivery of the wire is not stopped but the wire is immediately transferred to another empty reel so that the efficiency of the winding-up operation is improved. In wire take-up operation, the transfer of wire from a filled-up reel to another new or empty reel is the most important technique. For this reason, many proposals have been made in this concern. Particularly, there has been a tendency in recent years that wire winding-up operation is carried out at a considerably increased speed even up to several hundred meters per minute, so that it has become more and more important to transfer a wire winding-up operation from a reel to another one in a smooth and accurate manner and, further, in a manner to damage neither reels nor wire.

In the winding-up change-over technique which has been proposed, two reels are generally employed in such a manner that, while a wire is being taken up on one reel, the wire is transferred from the one reel to the other. Reels are arranged in two manners in one of which two reels are mounted in side to side relationship for rotation about a single axis and, when it is required to transfer the wire from one almost filled-up reel to the other empty one, a traverser which has been reciprocated above the reel is moved or shifted toward the above of said other reel. In the second manner, two reels are mounted for individual rotation about separate parallel axes and, when such transfer is required, the wire is urged away from the filled-up reel toward and into contact with the periphery of the wire winding-up drum of another empty reel. The peripheral speed of the drum is then adjusted to be the same as the speed of the wire being wound-up for preventing a breakage of the wire due to differential speed which otherwise will be imparted to the wire (such wire breakage is liable to take place in the first manner especially during a high speed winding-up operation). In the second manner of arrangement, wire is urged into contact with the wire winding-up drum in the following two fashions. In one of them, the wire itself is shifted away from a filled-up reel toward another reel while in the second fashion the wire is kept as it is and a new and empty reel is moved toward the wire, as having been proposed by the invention disclosed in Japanese Patent Publication No. 2968/62.

It is a primary object of the present invention to provide an improvement in a linear product take-up apparatus of the last-mentioned kind.

It is another object of the present invention to provide a linear product take-up apparatus of the kind mentioned above and in which smaller space is required for the movement of the reels so that the apparatus in its entirety may be of compact design.

It is a further object of the present invention to provide a linear product take-up apparatus of the kind mentioned in the above and in which the product is taken up at relatively lowered position so that it is possible to minimize violent and strong vibration which is liable to be produced during high speed winding-up operation, for assuring stabilization and hence long operative life of the apparatus.

It is a further object of the invention to provide a linear product take-up apparatus of the kind mentioned in the above and in which the rocking motion of a reel supporting frame for the transfer of the product brings a filled-up reel into a reel taking-off or unloading position in the apparatus to thereby simplify the operation of the apparatus.

It is a still further object of the invention to provide a linear product take-up apparatus of the kind above-mentioned and in which the product is not subject to differential winding-up speed during transfer of the product to a new empty reel to prevent a breakage of the product.

In order to achieve the above objects, the present invention provides a linear article taking-up apparatus comprising a frame structure rockable about a horizontal axis, said frame structure having rotatable shafts for supporting product take-up reels thereon for rotation therewith, said shafts being positioned on two apexes of a triangle whose remaining apex coincides with said horizontal axis, means for rotating said shafts, means disposed in a plane above said reels and mounted for movement at least in a direction parallel to said shafts to guide said linear product to one of said reels, disc means mounted on said shafts adjacent one ends of said reels for rotation with said shafts, means between said reels movable in a direction parallel to said shafts for shifting said linear product axially beyond said one ends of said reels when said one reel is substantially full of said product, actuator means for rocking said frame structure about said horizontal axis so that said full reel is moved to a reel take-off position and another empty reel is moved to a working position, said disc means having thereon means for engaging and arresting said linear product on said empty reel to change-over said product from said full reel to said empty reel. The means to guide the linear product may be also movable in a direction perpendicular to the shafts for the reels but, whether or not the guide means should be movable in this fashion depends on the angular range within which the frame structure is rocked about said horizontal axis by any conventional power means such as a fluid-operated cylinder. The frame structure is preferably designed to have a generally V-shaped configuration in side view and each of the legs of the V-frame is forked in the forward end to provide a pair of leg portions which support the above-mentioned shafts for the reels. The shafts may be driven to rotate together with the reels thereon by conventional motors mounted on the V-frame for movement therewith. The linear product shifting means include a linear product shifting bar and a conventional fluid-operated cylinder for moving the bar in a linear path. Furthermore, the linear product guide means may be moved in the above-stated fashion by conventional fluid-operated drive means.

The above and other objects and features of the present invention will become more apparent from the

following description with reference to the accompanying drawings.

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

FIG. 2 is a vertical sectional side elevation of the apparatus shown in FIG. 1 taken substantially along line II—II in FIG. 1;

FIG. 3 is a plan view of the apparatus shown in FIGS. 1 and 2;

FIGS. 4 through 10, inclusive, are diagrammatical illustrations of the operation of the apparatus and in which;

FIG. 4 illustrates the arrangement of two reels, a wire shifter, wire traverser etc. when the traverser is in a first position;

FIG. 5 is a view similar to FIG. 4 but illustrates the arrangement when the traverser is in a different or second position;

FIG. 6 illustrates the arrangement of the members as viewed in a direction indicated by an arrow VI in FIG. 4;

FIG. 7 illustrates the arrangement of the members as viewed in a direction indicated by an arrow VII in FIG. 5;

FIG. 8 is a view similar to FIG. 7 but illustrates the arrangement of the members when the traverser is axially moved to its one endmost position;

FIG. 9 is a view similar to FIG. 8 but illustrates the wire shifter which has been moved to its one endmost position; and

FIG. 10 is a view similar to FIG. 5 but illustrates the wire which is being transferred from one reel to another; and

FIGS. 11 and 12 illustrate the arrangements of reels, wire shifter, wire traverser etc. according to other embodiments of the present invention.

The present invention will be described hereunder in connection with preferred embodiments which are directed to wire take-up apparatus. It is, however, to be understood that the present invention is not limited to wire take-up apparatus but is applicable to take-up apparatuses for all kinds of linear products.

Referring first to FIGS. 1 to 3 of the drawings, there is shown an embodiment of the apparatus of the present invention generally indicated by 10 and comprising a base 11 and a pair of upright frames 12 and 13 adjacent the opposite ends of the base. The frames 12 and 13 are formed therein with openings 14 and 15, respectively.

As best seen in FIG. 2, provided on the base 11 is a pair of brackets 16 and 17 which cooperate together to rotatably support a horizontal shaft or axle 18. A frame 19, which is generally of V-shaped in side view, is pivotally mounted on the shaft 18. The V-shaped frame 19 has legs 20 and 21, as seen in FIG. 1, which are forked at the forward or free end portions to provide parallel leg portions 20*a* and 20*b* and 21*a* and 21*b*, respectively, as best shown in FIG. 2. The leg portions 20*a* and 21*a* carry thereon shorter pins 22*a* and 23*a*, respectively, which extend inwardly from these leg portions and which are adapted to be retracted outwardly by any conventional means such as fluid-operated piston and cylinder assemblies for the purpose which will become apparent later. The leg portions 20*b* and 21*b* carry axles 22*b* and 23*b* rotatably extending therethrough, respectively. The respective pairs of the pins and axles (22*a* and 22*b*; 23*a* and 23*b*) cooperate together to support reels R1 and R2.

The axles 22*b* and 23*b* extend beyond the associated leg portions 20*b* and 21*b* of the V-shaped frame 19 and have pulleys 24 and 25 on their outer ends, respectively, which are driven to rotate the reels R1 and R2 by appropriate conventional drive means. In the illustrated embodiment of the invention, the drive means comprise a pair of electric motors 26 and 27 mounted on one side of the V-shaped frame 19 and movable therewith. The motors 26 and 27 have pulleys 28 and 29, respectively, which are operatively connected by belts 30 and 31 to the pulleys 24 and 25 of the axles 22*b* and 23*b*, respectively.

For the purpose which will become apparent later, a disc 32 is rigidly secured onto the axle 22*b* between the associated reel R1 and the leg portion 20*b* for rotation together with the axle and hence the reel. Similarly, a disc 33 is fixed to the axle 23*b* between the reel R2 and the associated let portion 21*b* for rotation with the axle 23*b* and thus the reel R2. The discs 32 and 33 have claws 34*a* and 34*b* and 35*a* and 35*b* on the inner surface thereof, respectively, for the purpose which will be made apparent hereinafter.

A pair of straight bars 41 and 42 extend between the upper ends of the opposite upright frames 12 and 13. Blocks 43 and 44 are respectively mounted on the bars 41 and 42 for longitudinal sliding movement. A lateral bar 45 interconnects the blocks 43 and 44. A second lateral bar 46 is secured at one end to the block 43 and extends in parallel relationship with the bar 45. The bar 46 has turns of screw threads formed on the periphery thereof. The bar 46 supports thereon a slider 47 for sliding movement thereon laterally of the apparatus. The slider 47 has formed therein a through-hold having inner screw threads which loosely engage the screw threads on the bar 46. The slider 47 has a bracket 48 having a stud 49 extending therefrom in parallel relationship to the bars 45 and 46. A traverser or wire-guiding sheave 50 is mounted on the stud 49 for free rotation. The threaded bar 46 is adapted to be driven or rotated by any conventional driving means (not shown) to move the slider 47 and the sheave 50 laterally of the apparatus, or in other words, along a path which is in parallel relationship to the axes of rotation of the reels R1 and R2. The driving means may be a motor mounted on one of said blocks 43 and 44.

A link 51 is pivotally connected at one end to the slide block 44 and is hinged at the other end to one end of a second link 52 by a hinge pin 53. The link 52 is rigidly secured at the other end to a shaft 54 of any conventional drive means capable of oscillating or swinging, when required, the link 52 in the directions indicated by a double-headed arrow 52*a* so as to reciprocate the link 51 longitudinally of the apparatus as indicated by another double-headed arrow 51*a*. This reciprocal movement causes the traverser 50 to be moved longitudinally of the apparatus between the solid and broken line positions (C and B) illustrated in FIG. 1. The purpose of this movement will be made apparent later.

A wire shifter 60 is disposed between the reels R1 and R2. More specifically, the shifter 60 is formed by a

bar disposed between the legs **20** and **21** of the V-shaped frame **19**. The wire shifting bar **60** has its bottom end rigidly fixed to a block **61** which is slidably mounted on parallel shafts **62** and **63** extending in parallel relationship to the axes of rotation of the reels R1 and R2 and secured at their opposite ends to brackets **64** and **65** rigidly mounted on the V-shaped frame **19** between the legs **20** and **21** thereof.

A wire shifter actuator **66**, as shown in FIG. **3**, is suitably mounted on the V-shaped frame **19**. The actuator **66** may be a hydraulic or pneumatic piston and cylinder assembly which is operatively connected in known manner to a suitable fluid source (not shown). The piston or plunger of the actuator **67** has a rigid plate **67** secured to the free or forward end. Spacers **68** and **69** are mounted on the shaft **62** and **63** for sliding movement, respectively, and connect the plate **67** of the actuator piston or plunger with the block **61** of the wire shifter **60**. It will be appreciated that, when the piston and cylinder assembly **66** is actuated by fluid pressure, the block **61** is shifted together with the wire shifting bar **60** in the direction parallel to the axes of rotation of the reels R1 and R2.

A forked bracket **70** is rigidly secured to the base !1 adjacent one end thereof. The bracket **70** pivotally supports at the upper end a hydraulic or pneumatic piston and cylinder assembly **71** whose piston or plunger is hinged at the forward or free end to a bracket **73** suitably fixed to the V-shaped frame **19**. The assembly **71** is operatively connected to a suitable pressurized fluid source (not shown). Thus, it will be appreciated that, when the assembly **71** is actuated by fluid pressure, the V-shaped frame **19** is oscillated or rocked about its axle **18** so that the reels R1 and R2 are moved from the solid line position to broken line position shown in FIG. **1**. A pair of sets of steps **74** and **75** having resilient pads thereon are provided on the base **11** on opposite sides of the rocking axle **18** to resiliently stop the rocking movement of the V-shaped frame **19**.

The operation of the apparatus of the present invention will then be described with reference to FIGS. **4** through **10** of the drawings. Fig. **4** represents a state in which a wire is being taken up on a reel R2. In this position of the apparatus, the traverser **50** is in operation at the position C. A reel R1 is loaded on the leg **20** of the frame **19** while the reel R2 is winding-up the wire thereon. FIG. **6** schematically illustrates the arrangement of these and other members in this position of the apparatus as viewed in a direction indicated by an arrow VI in FIG. **4**. Assuming that the reel R2 has taken up the wire almost to its full volume or capacity or to its predetermined level, then another or empty reel R1 is driven to start rotation and is brought into condition that the peripheral speed of the wire winding-up drum of the reel R1 is the same as the linear speed of the wire at which it is being wound-up on the reel R2. At the same time, the transverser **50** is moved by the movements of the links **51** and **52** from the position C to the position B while the V-shaped frame **19** is also rocked by the piston and cylinder assembly **71** about the axle **18** in clockwise direction until the leg **21** engages and is stopped by the stops **75** and **75***a*. In this position of the apparatus, the wire is advanced in sliding contact with the periphery of the wire winding-up drum of the reel R1 and is being taken up by the reel R2 as shown in FIG. **5**. This position of the apparatus is viewed in a direction indicated by an arrow VII in FIG. **5** and is illustrated schematically in FIG. **7**. The wire is still being taken up by the reel R2 in the manner shown in FIG. **5** and, when the convolusions of the wire wound-up on the reel R2 has just reached the predetermined level for the reel, the traverser **50** is shifted by an appropriate signal to a position near to and above the discs **32** and **33** as shown in FIG. **8**. When this movement of the traverser **50** is completed, the wire shifting bar **60** is moved by the piston and cylinder assembly **66** from the position shown in FIGS. **6** and **7** to a position shown in FIG. **9** so that the bar **60** causes the wire to be pulled or urged axially outwardly of the disc **32** whereby the wire is engaged and arrested by one of the claws **34***a* as shown in FIG. **10**. The wire is then cut at a portion between the reels R1 and R2 and the end of the wire arrested by the claw **34***a* causes a further continuous length of the wire to be taken up by the reel R1. Thus, a transfer of wire winding-up operation from a reel to another one has been effectively and advantageously completed.

The above description is directed to the transfer of the wire winding-up operation from the reel R2 to the reel R1. When the convolusions of the wire taken up on the reel R1 has reached a full capacity of the latter reel, then the V-shaped frame **19** will be counderclockwise rocked to the full line position shown in FIG. **1** and the related members will operate in the manner similar to that described in the above to carry out the changing-over of the wire winding-up from the reel R1 to another empty reel R2.

FIGS. **11** and **12** illustrate modified embodiments of the present invention. In these embodiments, apparatuses **100** and **100***a* of the invention have traversers **500** and **500**which are not designed to be movable longitudinally of the apparatus but are adapted to be operable in fixed positions with respect to the lengths of the apparatuses. It will be apparent from the diagrammatical illustration in FIGS. **11** and **12** that the apparatuses **100** and **100**with longitudinally fixed traverses **500** and **500***a*, respectively, can easily be put into practice by suitably determining the angle within which V-shaped frames **190** and **190***a* are rocked.

As having been described in the above, the wire taking-up apparatus of the present invention employs a V-shaped frame with its axle **18** of rocking motion and the axes of rotation of a pair of reels R1 and R2 being positioned at or on respective apexes of an inverted triangle, so that the rocking motion of the frame **19** enables the two reels to alternatively have their winding operations at a substantially common position in the apparatus, with the result that it is possible for the two reels to be moved or rocked within a space which is remarkably smaller than that which is required by prior art wire taking-up apparatus employing reel-rocking arrangement. This feature of the present invention, therefore, enables the whole of a wire winding-up apparatus to have a more compact design. In addition, the traverser **50** may be designed so as not to be moved longitudinally of the apparatus or, even if the traverser is designed so as to be movable longitudinally of the apparatus between the solid and broken line positions (B and C), the distance between the two positions may advantageously be shortened considerably as compared

with prior art apparatus of this kind. Furthermore, the rocking motion of the V-shaped frame **19** brings a fully wound reel into a reel removing or unloading position so that the operation of the apparatus is greatly simplified. Still further, the wire is taken up generally at lowered position. This makes it possible to minimize violent and strong vibration which is encountered particularly in high-speed winding operation by use of prior art apparatus. Thus, the present invention eliminates the prior art drawback that the operative life of an apparatus of this kind has been shortened by the shock due to such vibration and the invention provides a wire take-up apparatus which is remarkably stable and operable for prolonged period of time. Still further, since the wire is kept in contact with the wire winding-up drum of an empty feel for all time during wire take-up changing-over operation from a working reel to an empty reel and since the wire is engaged by a claw on a disc on a reel driving axle while the wire is advanced in that fashion, there is encountered no wire breakage which otherwise will be produced by abrupt variation in the linear speed of the wire being wound-up. Thus, it may be said that the present invention provides a continuous take-up apparatus for linear article which apparatus can be of compact design and is advantageously applicable to high speed winding-up operation for all kinds of linear products.

What is claimed is:

1. A continuous take-up apparatus for a linear product comprising a generally V-shaped frame structure, actuator means for oscillating said frame about a horizontal axis between first and second positions, said frame structure having rotatable shafts parallel to said horizontal axis for supporting product take-up reels thereon for rotation therewith, said shafts being positioned on two apexes of a triangle whose remaining apex coincides with said horizontal axis, means for rotating said shafts, guide means disposed in a plane above said reels and mounted for movement at least in a direction parallel to said shafts to guide said linear product to one of said reels, shifting means between said reels movable in a direction parallel to said shafts for shifting said linear product axially beyond said one end of said reels when said one reel is substantially full of said product, said actuator means oscillating said frame about said horizontal axis so that said full reel is moved to a reel take-off position and another empty reel is moved to a working position, engaging means adjacent one end of each of said reels for engaging and arresting said linear product on said empty reel to changeover said product from said full reel to said empty reel.

2. A continuous take-up apparatus as claimed in claim **1** including means for moving said guide means in a direction laterally of said shafts within said plane.

3. A continuous take-up apparatus as claimed in claim **1** in which said means for rotating said shafts comprise a pair of motors mounted on said frame structure for movement therewith, said motors being each operatively connected to said shafts for rotating reels thereon.

4. A continuous take-up apparatus as claimed in claim **1** in which said means for shifting linear product include a linear product shifting bar mounted on said frame structure for reciprocal sliding movement in directions parallel to the axes of rotation of reels and a fluid-operated piston and cylinder assembly mounted on said frame structure, the piston of said assembly being connected to said linear product shifting bar.

5. A continuous take-up apparatus as claimed in claim **1** in which said frame has a pair of legs defining the V-shaped configuration terminating in free end portions, each of said legs being bifurcated at said free end portions to define a pair of parallel arms, one of said arms of each leg rotatably supporting said one of said shafts and the other of said arms of each leg having a pin member movable along its axis between an inner normal position an an outer retracted position.

6. A continuous take-up apparatus as claimed in claim **2** in which said linear product guide means include a pair of slide block members aligned in a direction parallel to said axes of rotation of reels, at least one lateral shaft member extending between said block members, a sheave member rotatably mounted on said lateral shaft member for guiding said linear product to a working reel, means on one of said slide block members for moving said sheave member along said lateral shaft member, and the means for moving said guide means in a direction laterally of said shafts includes force generating means and link means connecting said force generating means with one of said slide block members.

7. A continuous take-up apparatus for linear product comprising a frame structure mounted for oscillatory movement about a horizontal axis between first and second positions said frame structure having rotatable shafts for supporting product take-up reels thereon for rotation therewith, said shafts being positioned on two apexes of a triangle whose remaining apex coincides with said horizontal axis, means for rotating said shafts, guide means disposed in a plane above said reels, and mounted for movement in a first direction parallel to said shafts to guide said linear product to one of said reels, means for moving said guide means in a second direction laterally of said shafts within said plane, shifting means between said reels movable in a direction parallel to said shafts for shifting said linear product axially beyond said one end of said reels when said one reel is substantially full of said product, actuator means for oscillating said frame structure about said horizontal axis so that said full reel is moved to a reel take-off position and another empty reel is moved to a working position, engaging means adjacent one end of each of said reels for engaging and arresting said linear product on said empty reel to changeover said product from said full reel to said empty reel.

8. A continuous take-up apparatus as claimed in claim **7** wherein said linear product guide means includes a pair of slide block members aligned in a direction parallel to said axes of rotation of reels, at least one lateral shaft member extending between said block members, a sheave member rotatably mounted on said lateral shaft member for guiding said linear product to a working reel, means on one of said slide block members for moving said sheave member along said lateral shaft member and the means for moving said guide means in a direction laterally of said shafts includes force generating means and link means connecting said force generating means with one of said slide block members.

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