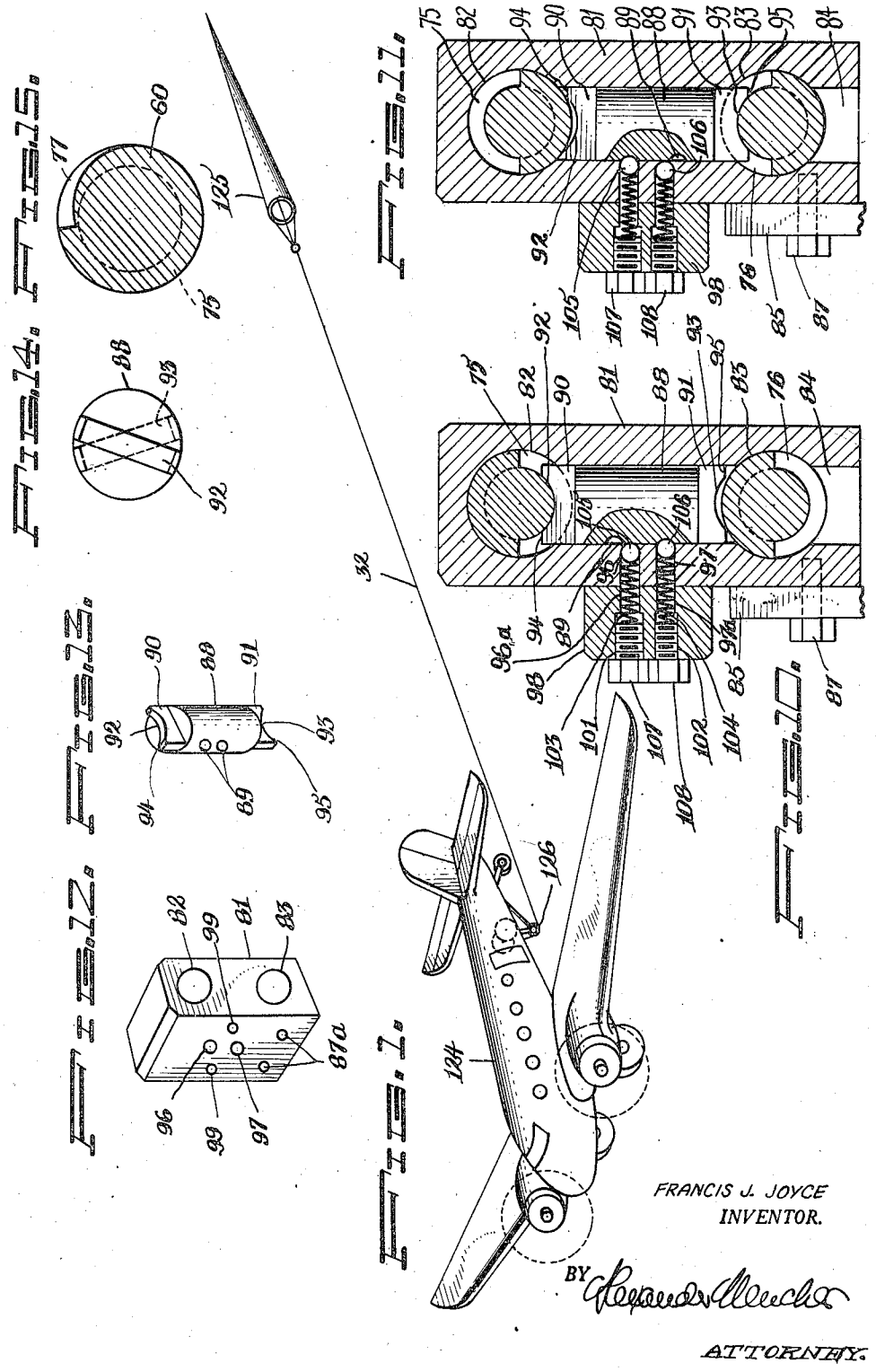
May 27, 1947. F. J. JOYCE 2,421,269

STRAND WINDING APPARATUS

Filed June 21, 1943 5 Sheets-Sheet 1

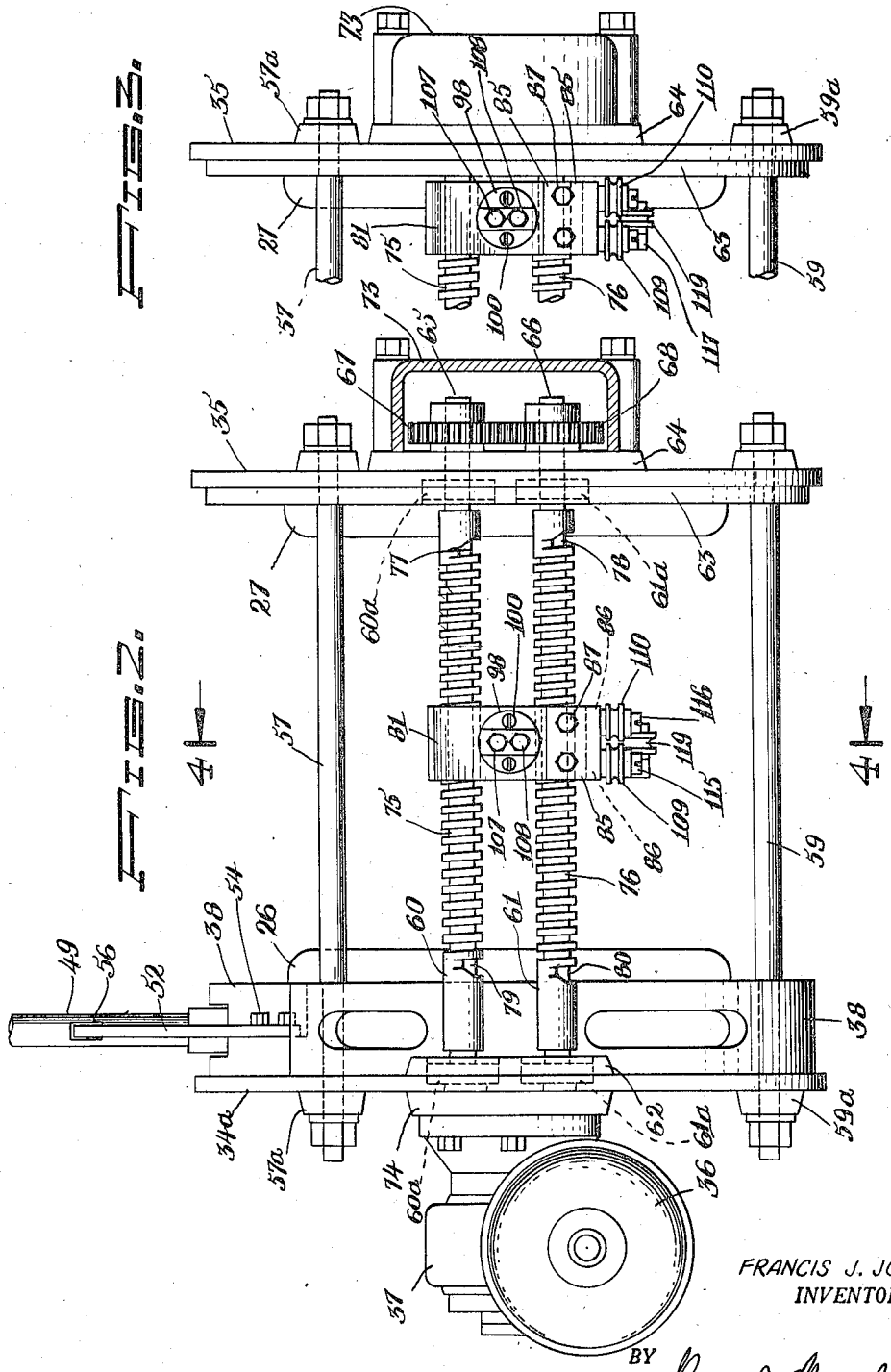


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STRAND WINDING APPARATUS

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FIG. 2.



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STRAND WINDING APPARATUS

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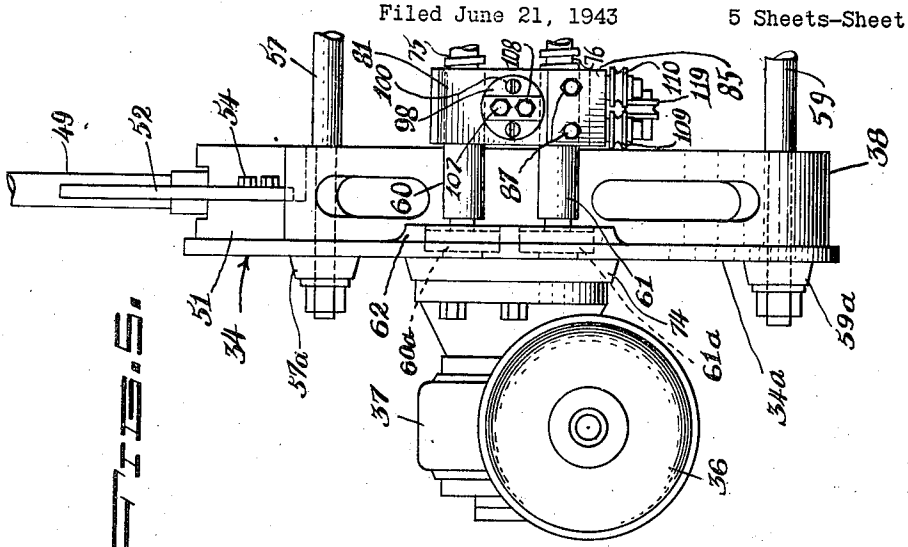


FIG. 5.

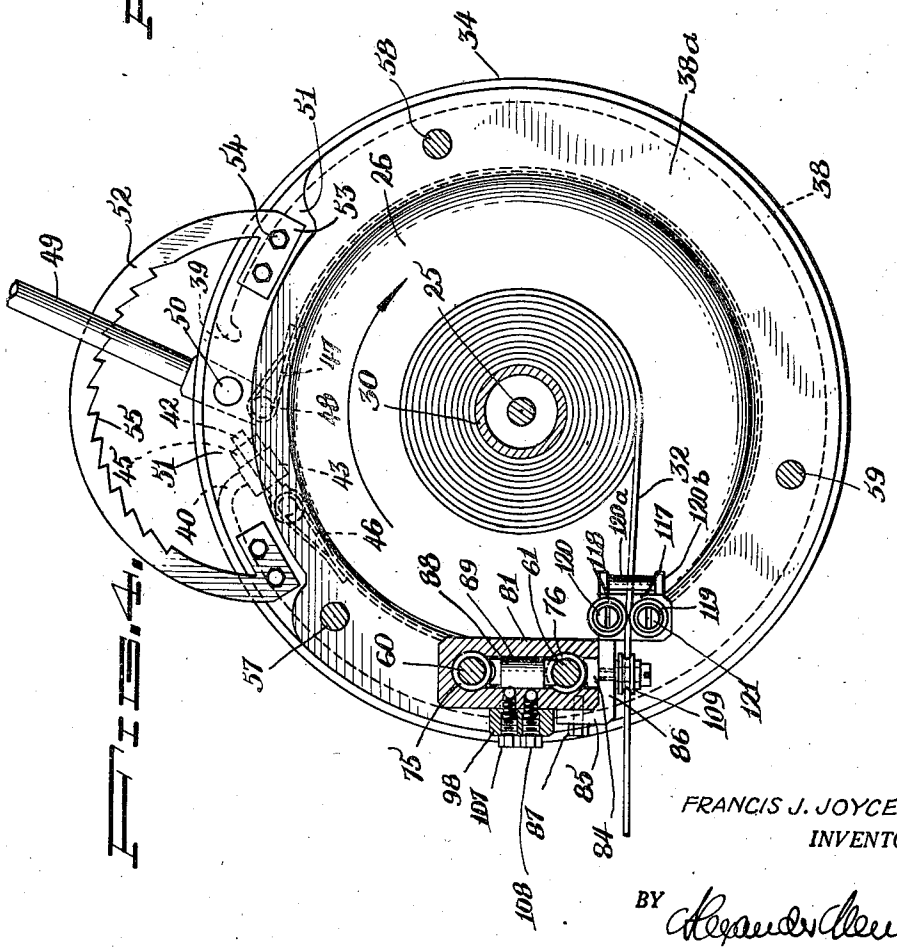


FIG. 4.

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STRAND WINDING APPARATUS

Filed June 21, 1943 5 Sheets-Sheet 4

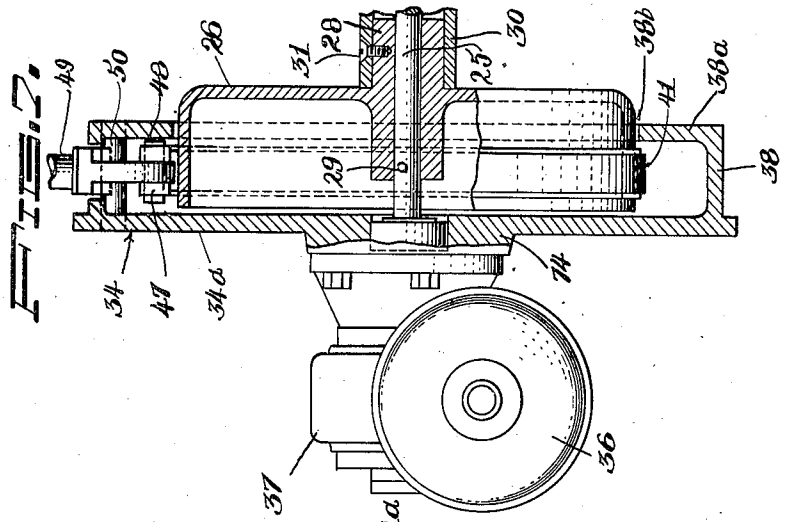


FIG. 7.

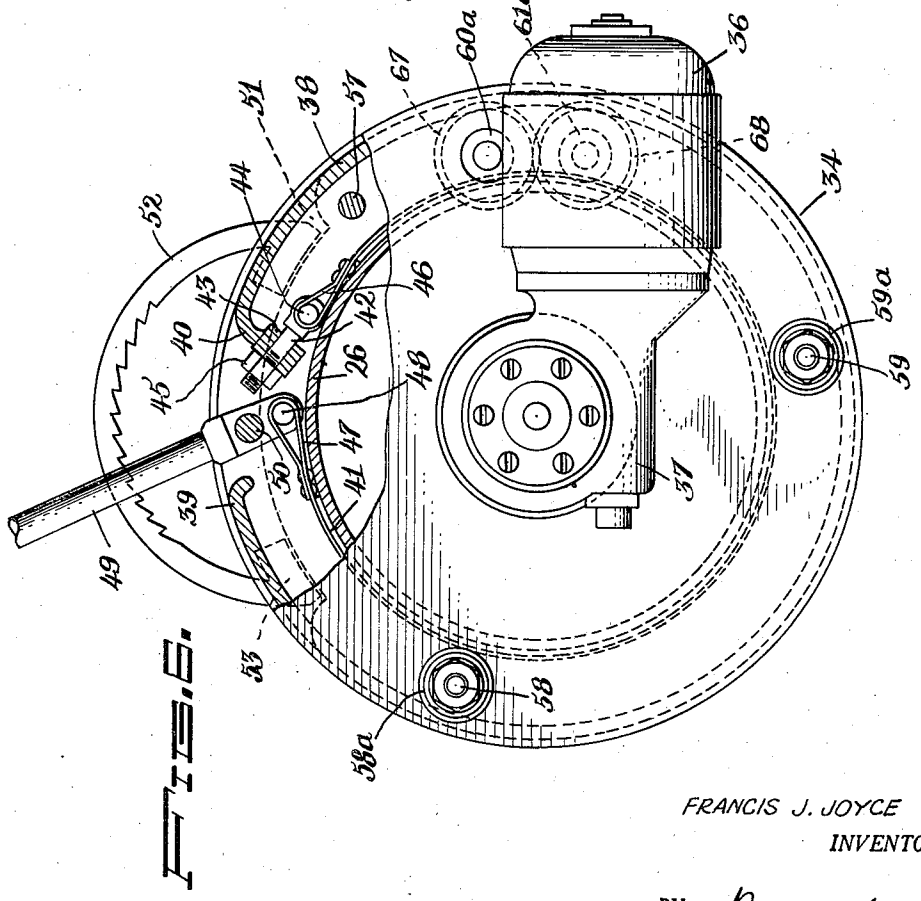


FIG. 5.

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STRAND WINDING APPARATUS

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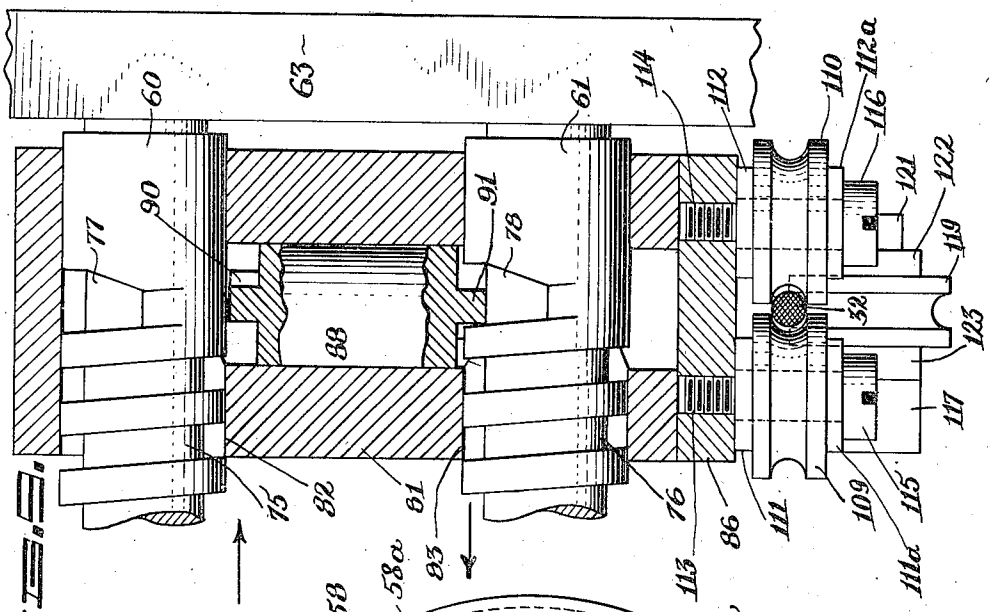


FIG. 1.

FIG. 2.

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Patented May 27, 1947

2,421,269

UNITED STATES PATENT OFFICE

2,421,269

STRAND WINDING APPARATUS

Francis J. Joyce, Keyport, N. J.

Application June 21, 1943, Serial No. 491,593

4 Claims.. (Cl. 242—158)

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This invention relates to a strand winding apparatus.

The main object of the invention resides in the provision of a distributor for winding apparatus wherein the traversable member is so associated with rotatable lead shafts as to minimize vibration therebetween and resulting thereby in a smoother and more accurate wind on the winding or take-up reel.

A further object of the invention resides in the provision of a distributor associated with a winding apparatus wherein there is firm sliding engagement over a substantial area at all times between at least one of the cam followers of said distributor and at least one of the cam tracks or dwell cam surfaces of the lead shafts to prevent loose and neutral relationship. Loose or neutral engagement between the cam followers and the lead shafts leads to a shifting of the distributor caused by the side loads of the cable when the said distributor is at the end positions corresponding to the end positions of the winding or take-up reel. Such a shifting results in a non-uniform winding, fouling, jamming and unsmooth operation of the apparatus, disadvantages which the present invention overcomes.

Another object of the invention resides in the provision of rotating lead shafts associated with the distributor wherein the shafts have unidirectional spiral tracks thereon as distinguished from intersecting tracks for effecting reciprocatory movements of the distributor, the use of such unidirectional tracks affording threads of smaller pitch, a greater area of contact between the cam followers of the distributor and the tracks of the shafts and elimination of damage to the apparatus by eradicating possible jamming between the cam followers and the shaft tracks. Longer life and economy in the cost of manufacture of lead shafts are also accomplished by the use of unidirectional tracks.

A further feature of the invention resides in the provision of a member having cam followers at the opposite ends and being mounted in the sliding block of the distributor for vertical reciprocation at spaced intervals to alternate the direction of movement of the distributor longitudinally of the winding or take-up reel.

Another object of the invention resides in the provision of lead shafts having opposed dwell cam surfaces at the opposite ends thereof and so timed as to disengage one follower from one shaft and engage the other follower to the other shaft for reversing the direction of movement of the distributor, such dwell cam surfaces also serving as

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a momentary dwell or stop to the movement of the distributor.

Another end of the invention resides in the use of lead shafts in conjunction with the distributor having more threads to the inch and permitting suitable ratios between the speed of rotation of the lead shafts and the winding reel determinable by the diameter of the cable and the pitch of the shaft threads or tracks.

These objects and other incidental ends and advantages of the invention will hereinafter appear in the progress of the disclosure and as pointed out in the appended claims.

Accompanying this specification are drawings illustrating a form of the invention wherein corresponding reference characters designate corresponding parts throughout the several views and wherein:

Figure 1 is a view in perspective showing the winding apparatus generally as applied to an airplane, the strand or cable being secured at one end to a target.

Figure 2 is a front view in elevation, partly in section, of the winding apparatus including the traversable member of the distributor, the lead shafts therefor, the end drums of the winding reel and actuating means.

Figure 3 is a front view in elevation of the right hand side of Figure 2 showing the distributor at the ends of the lead shafts preparatory to reversal of movement thereof.

Figure 4 is a sectional view of Figure 2 along the plane 4—4 thereof.

Figure 5 is a front view in elevation of the winding apparatus showing the left hand side of Figure 2 with the distributor at the left end of the lead shafts preparatory to reversal of movement thereof.

Figure 6 is an end view in elevation, partly broken away, showing the end of the winding apparatus.

Figure 7 is a fragmentary view, partly in section, showing the end of the winding reel secured to an end frame member or housing to which is secured a motor and a reduction gear box.

Figure 8 is an end view in elevation, partly in section, of the other end member of the frame of the winding apparatus including a gear train transferring motion from the driven shaft of the winding reel to the lead shafts.

Figure 9 is a vertical sectional view along the axes of the lead shafts showing one of the two cam followers thereof in the act of engaging the lower lead shaft through a dwell cam surface thereon.

Figures 10 and 11 are vertical sectional views across the lead shafts showing the distributor and the lead shafts in engagement for right hand and left hand movements thereof respectively.

Figure 12 is a view in perspective showing the sliding block of the distributor.

Figure 13 is a view in perspective of a cylindrical member showing cam followers at the opposite ends thereof.

Figure 14 is a top view in elevation of the member shown in Figure 13.

Figure 15 is a transverse sectional view of the dwell cam surface at the ends of the lead shafts for transferring the engagement between one follower and the tracks of one lead shaft to the other follower and the tracks of the other lead shaft to effect reversal of movements of the distributor longitudinally of the winding reel.

As an illustration of the invention, a winding apparatus having a rotating winding or take-up reel and a distributor for distributing strand or cable thereon in superimposed layers as the strand or cable is wound thereon and for unwinding strand or cable therefrom in reverse order is shown in the drawings. A conventional winding reel is provided having a driven shaft 25 covered by a hub 28 and end drums 26 and 27, the hub being suitably secured to shaft 25 as by a pin 29 as best seen in Figures 2, 4 and 7. A sleeve 30 is suitably secured to hub 28 as by set screws, one of which is indicated by numeral 31, the sleeve 30 in conjunction with drums 26 and 27 serving as the take-up reel of the apparatus for strand or cable 32, the latter having one end thereof suitable secured to sleeve 30 contiguous to one of the drums 26 and 27, such connection of the cable not being shown in the drawings.

Driven shaft 25 carrying the winding reel is suitably journaled for rotation in bearings of a frame comprised of a housing generally designated by numeral 34 as one end member and an opposite plate 35 as the other end member. The housing 34 is adapted to serve as a mounting for a conventional braking mechanism for the movement of cable 32 and has an outer wall 34*a* to which is secured a power source such as motor 36 and a reduction gear box 37, a gear of which (not shown) drives shaft 25 for rotating the winding reel. Housing 34 is furthr provided with an annular portion 38 spaced inwardly of the periphery of wall 34*a* and an inner wall 38*a*. Annular portion 38 as shown in Figures 4, 6 and 7 is provided with an opening at the top thereof between downwardly turned ends 39 and 40, while the inner wall 38*a* is provided with a central opening 38*b* to admit a portion of end drum 26 within housing 34 for rotation therewithin, said portion of the drum within the housing serving as a brake shoe for brake band 41.

One end of the band 41 is secured to the annular portion 38 at end 40 as by a threaded bolt 42 engaging an internally threaded lug 43 secured to end 40 as shown in Figure 6. One end of bolt 42 has a pin or stud 44 while the other end is threaded and has a nut 45 securable against lug 43, the stud 44 carrying end loops 46 secured to one end of brake band 41. End loops 47 are provided at the opposite end of brake band 41 and are engageable with a stud 48 which is secured to the lower end of a lever arm 49 pivoted on a shaft 50 extending between outer wall 34*a* and inner wall 38*a* of housing 34. A bracket 51 is suitably affixed to housing 34 to which an arcuate ratchet segment 52 is secured at inwardly turned lugs 53 by nuts 54. The segment 52 has inner

ratchet teeth 55 which are adapted to engage with a depressible pawl within lever 49, the said pawl not being shown in the drawings. An opening 56 within lever 49 is provided for penetration of segment 52 therethrough to permit free pivotal movement.

The novel distributor generally includes a sliding block traversable on a pair of lead shafts, the block having suitable guide rollers for the cable to be distributed and cam followers to engage cam tracks and cam surfaces on the shafts for purposes of distributing the strand or cable on the winding or take-up reel in superimposed layers as the strand or cable is wound thereon and for unwinding strand or cable therefrom in reverse order.

Thus, numerals 60 and 61 indicate a pair of lead shafts spaced forwardly and centrally of the winding reel as shown in Figurs 2, 4 and 8 and are disposed longitudinally of and parallel with said winding reel and in vertical alignment, the shafts serving as a mounting for the sliding block (hereinafter to be described). Each of the shafts 60 and 61 at expanded portions 60*a* and 61*a* is suitably journaled in the end members 34 and 35 of the frame at reinforced areas 62 and 63—64 respectively.

Rotating motion is imparted to shafts 60 and 61 in any conventional manner such as by a train of gears deriving motion from a gear at one end of shaft 25 of the take-up reel, shaft 25 being driven at the other end by a source of power such as motor 36 through a gear of the gear box 37 secured to end member 34 as reinforced area 74 as shown in Figures 2 and 8. Shafts 60 and 61 have extensions 65 and 66 penetrating the end member 35. At the ends of extensions 65 and 66 are intermeshing gears 67 and 68 of the same diameter to impart opposite rotation to the shafts. As shown, the driving gear 69 at that end of shaft 25 which penetrates end member 35 is of half the diameter of gears 67 and 68 and imparts motion to gear 67 by a train of idlers 70, 71 and 72 whereby the ratio of movement of the shafts to the winding reel is as 1:2. The ratio, however, is determinable by the diameter of the cable to be wound on the reel and the pitch of the lead shaft cam tracks to be now described. Lead shafts 60 and 61 are provided with similar spiral cam tracks 75 and 76 respectively on the periphery thereof and as shown form right hand screws with the shafts. Cam tracks 75 at the end portions communicate with cam surfaces 77 and 79 while cam tracks 76 at the end portions communicate with similar cam surfaces 78 and 80. All of the aforementioned cam surfaces have a width sufficient to accommodate the angle of the cam followers (the latter to be hereinafter described in association with the traversable distributor guide block of the apparatus) and taper off from the depth of the cam tracks 75 and 76 to the surface of the shafts within a small angle such as substantially a 45–90 degree angle as shown in Figure 15 to serve both as a momentary dwell to the movement of the cam followers and to transfer engagement between one cam follower and the tracks of one shaft to the other cam follower and the tracks of the other shaft to reverse movement of the guide or sliding block longitudinally of the winding or take-up reel.

The distributor guide or sliding block above mentioned is indicated by numeral 81 and is provided with a pair of spaced and aligned horizontal cylindrical openings 82 and 83 for movable support by engagement with shafts 60 and 61,

openings 82 and 83 communicating with a central and vertical bore 84, cylindrical in shape and open at the bottom as shown in Figures 4, 10 and 11. A bracket having a front leg 85 and a lower leg 86 is secured to the front wall of block 81 by bolts 87 penetrating openings 87a and is adapted both to close the bottom opening of bore 84 and to carry suitable guide rollers for cable 32.

Insertable within bore 84 of the distributor sliding block 81 is a member 88 shown as being cylindrical in shape and carrying the aforementioned cam followers or tongues indicated by numerals 90 and 91. The followers are at opposite ends of member 88, the latter being mounted for vertical reciprocatory movement within sliding block 81 for alternate engagement between one follower and tracks 75 and the other follower and tracks 76. This alternate engagement is effected by the action of the pairs of opposing dwell cam surfaces 77—78 and 79—80 at the ends of the tracks.

Thus, cylindrical member 88 is provided with a pair of vertical aligned and spaced semi-spherical recesses 89, 89—each recess being alternately engageable with a corresponding suitable but preferably yieldable bearing to effectuate engagement either between the follower 90 and shaft 60 or the follower 91 and shaft 61 and to effectuate intermediate engagement of both shafts by the followers when member 88 is between the opposed cam surfaces 77—78 and 79—80 during the interval of displacement. Followers 90 and 91 operate the sliding block 81 for traverse on the shafts and as shown are in the form of opposite tongue members at oppositely disposed angles as best shown in Figure 14 to accommodate the track directions of shafts 60 and 61. The tongue of follower 90 has a concave upper cam surface 92 extending from end shoulders 94 and the tongue of follower 91 has a concave lower cam surface 93 extending from end shoulders 95, the cam surfaces 92 and 93 having contours and widths corresponding to the contours and widths of the engageable tracks 75 along the lower side of shaft 60 and the tracks 76 along the upper side of shaft 61 during movements in the opposite right and left hand directions respectively. Such a fit between the cam follower surfaces 92 and 93 and tracks 75 and 76 prevents vibration and displacement between sliding block 81 and shafts 60 and 61 at these areas to insure smooth operation.

The bearings previously mentioned are suitably associated with a cylindrical member 88 to permit vertical reciprocal movement at spaced intervals. These bearings are engageable with semi-spherical recesses 89, 89 disposed in spaced and vertical alignment along a side of member 88. The mounting for such bearings includes a block 98 having a pair of vertically aligned and spaced bores 96a and 97a offset from recesses 89, 89 by the depth of tracks 75 or 76, said bores communicating with bores 96 and 97 in the front wall of sliding block 81, as best shown in Figures 10 and 11. Block 98 is securable to the front wall of sliding block 81 through bores 99 (Figure 12) as by screws 100 (Figure 2) and is provided with vertically aligned and internally threaded passages 101 and 102 reduced at the inner ends to form the aforementioned bores 96a and 97a. Springs 103 and 104 having ball bearings 105 and 106 at the inner ends thereof proceed through communicating bores 96a—96 and 97a—97 respectively, said springs at the outer ends being secured to bolts 107 and 108 engaging threaded passages 101 and 102 of block 98.

As shown in Figure 10, when the upper follower 90 is in engagement with track 75 of shaft 60, bearing 106 engages the lower spherical recess 89 of cylindrical member 88 while bearing 105 is disposed below the upper spherical recess 89. When the lower follower 90 is in engagement with track 76 of shaft 61 as shown in Figure 11 bearing 105 engages the upper spherical recess 89 of member 88, while bearing 106 is disposed above the lower spherical recess 89. In the intermediate portion of member 88 when it is being displaced from one spiral track to the other of shafts 60 and 61 by the opposing cam surfaces 77—78 and 79—80, one bearing (either 105 or 106) is forced out of one spherical recess 89 at the same time that the other bearing enters the other spherical recess. In this way, cylindrical member 88 always maintains a proper vertical position with respect to shafts 60 and 61.

An appropriate cable guide is suitably secured to the sliding block 81. As shown especially in Figures 4 and 9, two pairs of cooperating pulleys and a pair of elongated rollers are provided. The first pair of pulleys 109 and 110 are horizontally disposed and suitably spaced for cable 32 to slide therebetween. Pulleys 109 and 110 are secured to bracket wall 86 by threaded ends 113 and 114 of shank members having screw heads 115 and 116, the shank members serving as axles for said pulleys. On both sides of pulley 109 are suitable bearing discs 111 and 111a while on both sides of pulleys 110 are similar discs 112 and 112a.

A second pair of spaced pulleys 118 and 119 are provided rearwardly of pulleys 109 and 110 and are secured to a block 117 affixed to the rear edge of bracket wall 86, the said pulleys being disposed in vertical alignment and mounted against block 117 by shanks having screw heads 120 and 121 and threaded ends not shown. Pulley 119 is provided with similar bearing discs 122 and 123, while pulley 118 is also provided with similar discs not shown.

As seen in Figure 4, cable 32 passes between pulleys 109—110 and 118—119 along a straight horizontal line. To maintain the portion of cable 32 directly behind pulleys 118 and 119 in a vertical plane so that said pulleys may not be fouled by a deflection of this portion of the cable induced by an interruption in the load (as by air pockets), a pair of spaced and vertically disposed elongated rollers 120a are provided directly behind pulleys 118 and 119, the said rollers being secured to block 117 as by brackets 120b.

Numeral 124 indicates a plane in which the winding apparatus may be mounted while numeral 125 indicates the target carried at one end of cable 32. Suitable rollers diagrammatically shown by numeral 126 are mounted on the plane to serve as a guide for cable 32 between the guide or sliding block 81 and the target 125. Although the apparatus is shown in connection with a target towed by an airplane, it is understood that the apparatus is applicable to other known commercial uses.

When the winding reel goes in a clockwise direction as shown in Figures 4, 8 and 9 for unwinding cable 32, shaft 60 goes in a clockwise direction and shaft 61 in a counterclockwise direction since shafts 60 and 61 are right hand screws. The sliding block 81, when cam surface 92 of follower 90 engages tracks 75, will go toward the right in the direction of the arrow in Figure 9 until the follower 90 is thrown off tracks 75 by the communicating and tapered dwell cam 77 of shaft 60 preferably within a rotational angle of between

45 and 90 degrees. During the time of this displacement, follower or tongue 91 at surface 93 engages the opposite and tapered dwell cam surface 78 of shaft 61 within the same rotational angle of 45–90 degrees. The communication between the dwell cam surface 77 and tracks 76 brings about the engagement between follower 91 and tracks 76 causing the sliding block 81 to travel along shaft 61 in the oppisite direction or to the left as indicated by the arrow in Figure 9 until follower 91 engages the dwell cam surface 80 communicating with tracks 76. At this time, member 88 is thrown out of engagement with the lower shaft 61 and enters the dwell cam surface 79 on shaft 60 for engagement between follower 90 and tracks 75.

It is to be noted that cylindrical member 88 is never in a neutral position with respect to shafts 60 and 61. This prevents any possibility of lateral displacement along said shafts that might be caused by the side loads of cable 32 when sliding block 81 is at the limiting end positions. Such a neutral position at the reversal points is avoided by partial engagement between the pairs of cam surfaces 77—78 and 79—80 during the initial phases of displacement for reciprocating the movement of the sliding block 81.

Not only is there no vibration between member 88 or sliding block 81 mounted for vertical movement therein and tracks 75 and 76 of shafts 60 and 61, but there is also no vibration at the cam surfaces of the tracks because the width of each of the dwell cam surfaces 77, 78, 79 and 80 is equal to the horizontal distance between the ends of the followers or tongues 90 and 91. It is to be observed that at the interval when one cam follower is disengaged from one shaft and the other follower engaged in the other shaft, sliding block 88 is in a momentarily stationary condition, this condition lasting for about a quarter of one revolution of the shafts.

It is understood that shafts 60 and 61 need not rotate in opposite directions; for if shaft 61 were a corresponding left hand screw rotating at the same rate and in the same direction as the right hand screw or threaded shaft 60, the same reciprocating movements could be effected as heretofore described.

I wish it further understood that minor changes and variations in the size, material, integration and subcombination of parts illustrating the invention herein may all be resorted to without departing from the spirit of the invention and the scope of the appended claims.

I claim:

1. In a cable winding apparatus having a rotating drum mounted between end plates and a distributor for distributing cable thereon from an airplane towing device in superimposed layers as the cable is wound thereon and for unwinding cable therefrom in reverse order, a pair of rotatable shafts mounted between said end plates and on which said distributor is traversable, cam tracks on each of said shafts for effecting opposite movements to said distributor longitudinally of said drum, means at the ends of the tracks of each shaft and rotatable therewith to reverse the movement of said distributor, movably mounted corresponding cam followers for the shafts carried by the distributor and provided with concave engaging surfaces transverse to the axes of the shafts, guides carried by the distributor to absorb imposition of side loads by the drum and the cable extending from the drum, each follower being alternately engageable with the tracks and means of the corresponding shaft for effecting reciprocatory movements to said distributor.

2. Means for distributing metal cable on a drum, said means including a pair of movable cams, a pair of corresponding cam followers, a housing in which said cam followers are mounted for vertical reciprocation, rollers secured to said housing to guide said cable passing to and from the drum, terminal cam members forming part of said movable cams, each of the cam followers being engageable with a corresponding terminal cam member alternately for effecting reciprocatory movements to said housing longitudinally of said drum.

3. Means for distributing a metallic cable on a drum comprising a pair of elongated rotatable screws, a slidable member having followers at opposite ends adapted to selectively engage said screws, a housing for said member, restraining guide members secured to said housing for rotatably engaging the cable passing to the drum, and means including cams, one at each end of and connected to, said screws, for disconnecting one of the followers from one of the screws and moving the other follower into engagement with the other one of said screws.

4. Means for distributing a metallic cable on a drum comprising a pair of elongated rotatable screws, a slidable member having concave followers at opposite ends adapted to selectively engage said screws, a housing for said member, restraining guide members secured to said housing for rotatably engaging the cable passing to the drum, and means including cams, one at each end of and connected to, said screws, for disconnecting one of the followers from one of the screws and moving the other follower into engagement with the other one of said screws.

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