Oct. 13, 1964 W. B. BROWN 3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

Filed Dec. 28, 1962 5 Sheets-Sheet 1

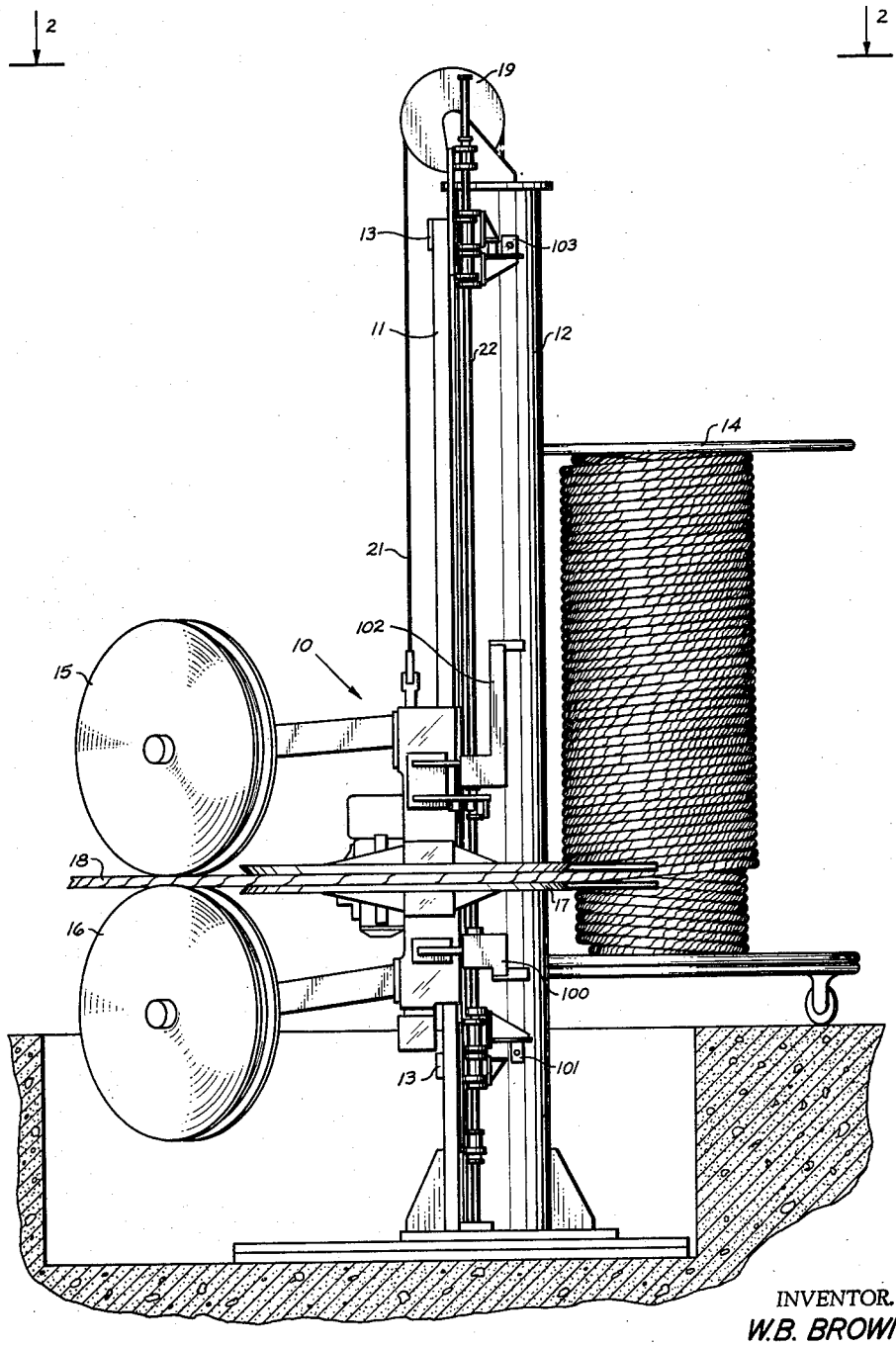


FIG. 1

INVENTOR.
W.B. BROWN

BY S. Gundersen

ATTORNEY

Oct. 13, 1964 W. B. BROWN 3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

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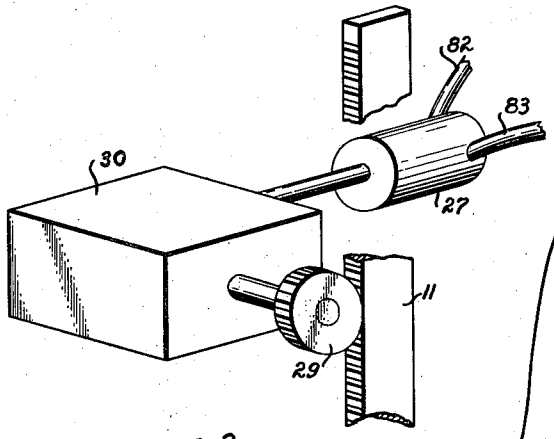


FIG. 3

FIG. 2

INVENTOR.
W.B. BROWN
BY S. Gundersen
ATTORNEY

Oct. 13, 1964 W. B. BROWN 3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

Filed Dec. 28, 1962 5 Sheets-Sheet 3

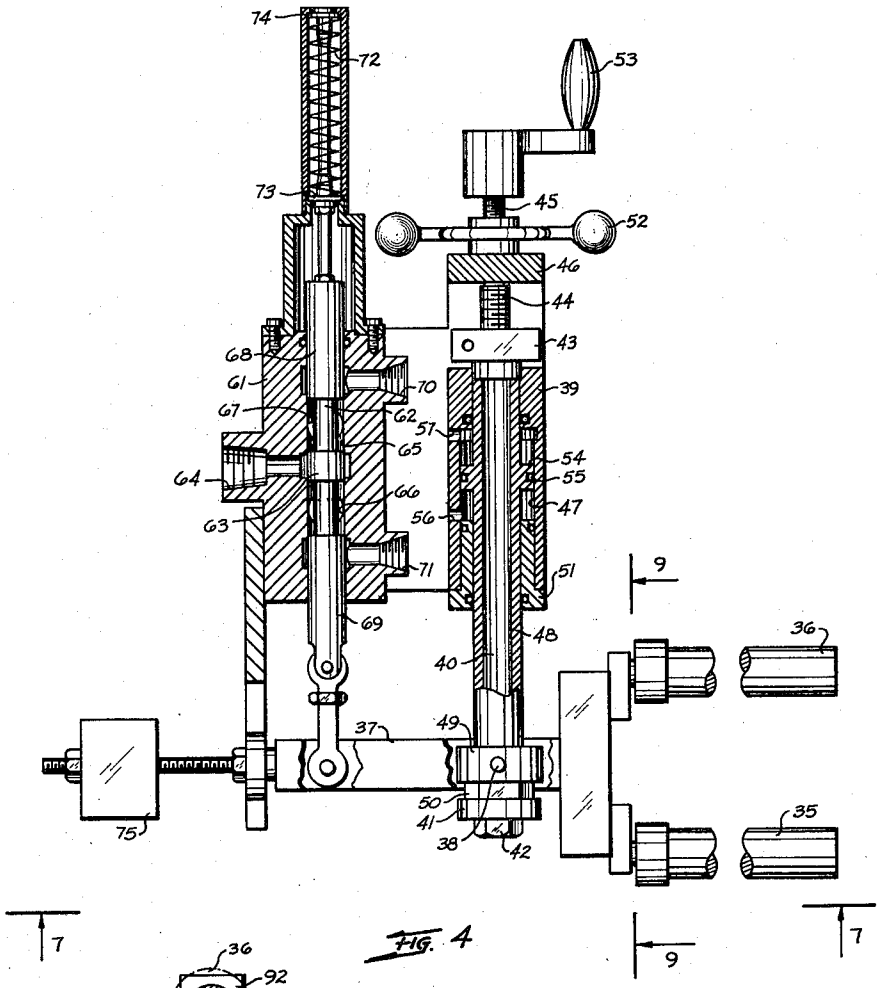


FIG. 4

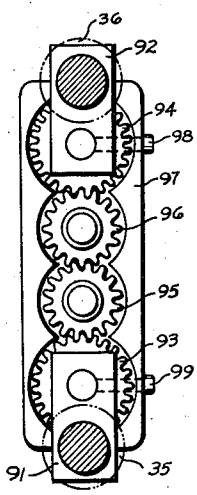


FIG. 9

INVENTOR.
W.B. BROWN
BY
S. Gundersen
ATTORNEY

Oct. 13, 1964 W. B. BROWN 3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

Filed Dec. 28, 1962 5 Sheets-Sheet 4

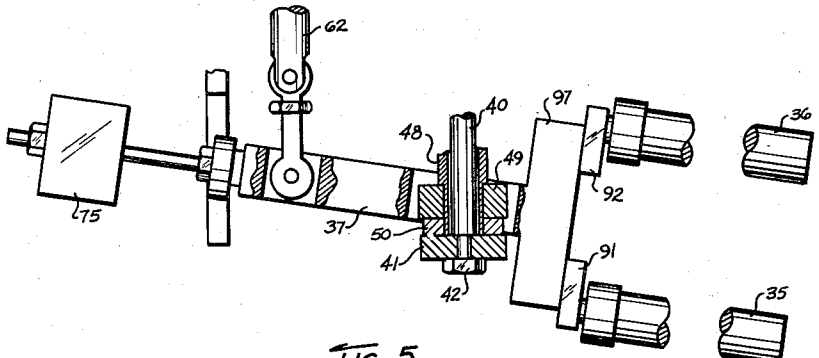


FIG. 5

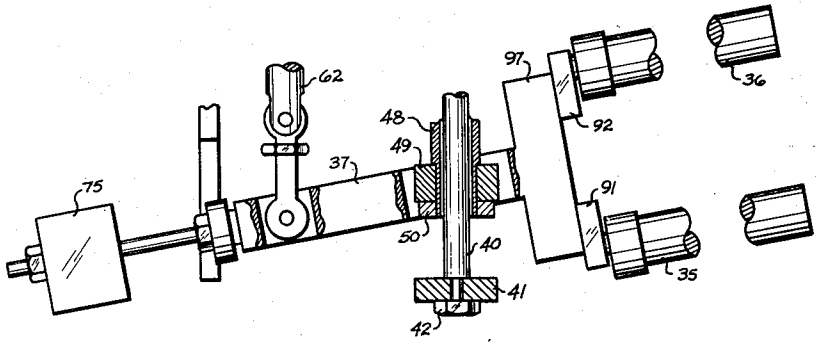


FIG. 6

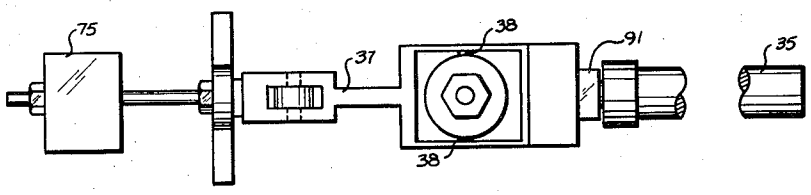


FIG. 7

INVENTOR.
W.B. BROWN
BY S. Gundersen
ATTORNEY

Oct. 13, 1964 W. B. BROWN 3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

Filed Dec. 28, 1962 5 Sheets-Sheet 5

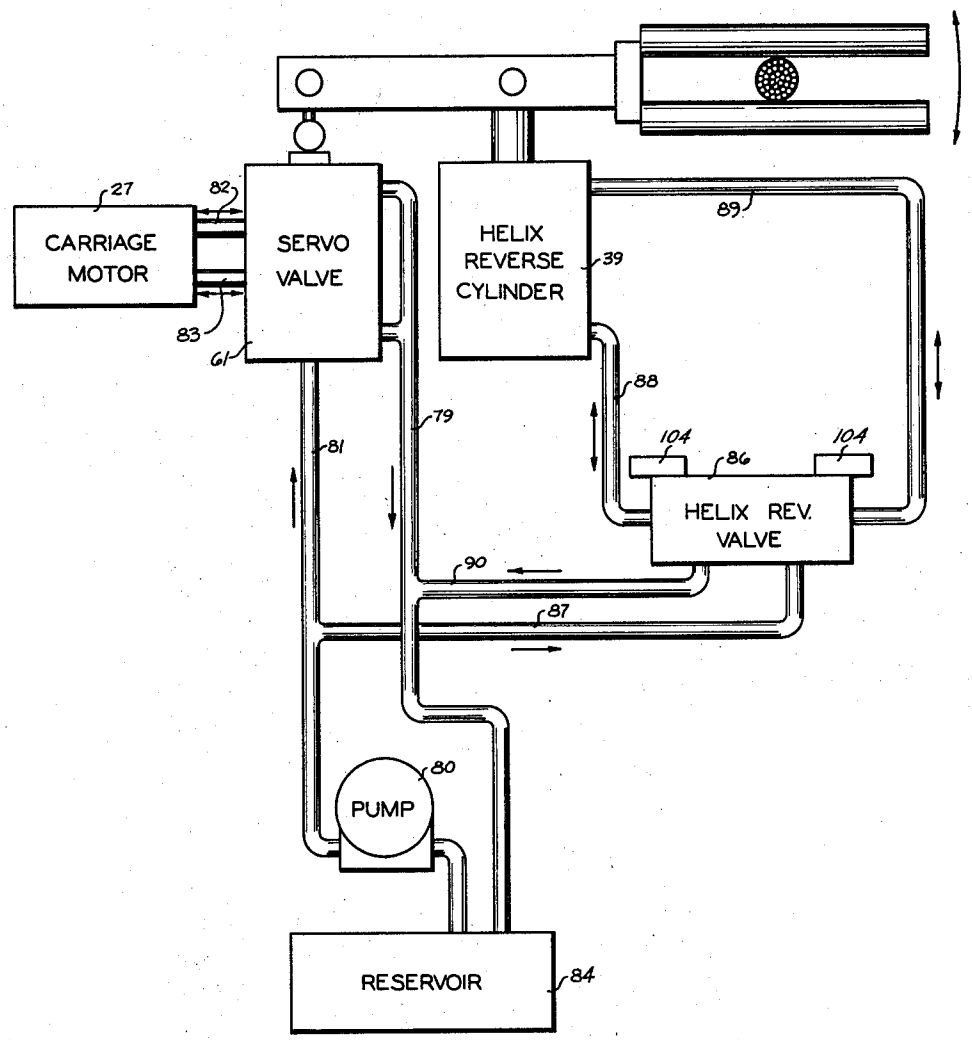


FIG. 8

INVENTOR.
W.B. BROWN
BY S. Gundersen
ATTORNEY

United States Patent Office 3,152,773 Patented Oct. 13, 1964

3,152,773

DEVICE FOR CONSTANTLY CORRECTING THE ANGLE A STRAND MAKES WITH A REEL

William B. Brown, Pasadena, Md., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed Dec. 28, 1962, Ser. No. 248,088
5 Claims. (Cl. 242—157.1)

This invention relates to a strand-guiding apparatus and particularly to an apparatus for constantly correcting the angle a strand makes with a reel when taken up onto or pulled off of the reel.

In winding a strand on a reel, a strand guide is commonly used which traverses the reel as the reel rotates, so as to guide the strand onto the reel. The position the strand guide takes with respect to the reel determines the angle the strand makes with the reel. This angle is commonly referred to as the helix angle. If the strand does not make the proper helix angle with the reel, the strand will be laid improperly on the reel so as to necessitate rereeling and/or it will rub against adjacent convolutions on the reel so as to damage the strand. This rubbing of the strand against the adjacent convolutions results in wear and abrasion of the strand, whereby the strand is damaged. This is particularly acute where a strand-guiding apparatus is used which handles a variety of different strands having different diameters, as difficulty is experienced in adjusting the travel of the strand guide with respect to the reel so as to properly guide a strand onto the reel regardless of the diameter of the strand.

The same difficulties are experienced in unreeling a strand as, if the strand guide is not properely positioned relative to the reel, the strand rubs against adjacent convolutions on the reel so as to damage the strand.

It is, therefore, an object of this invention to provide facilities for constantly correcting the angle a strand makes with a reel.

A further object of this invention is to provide facilities for maintaining a preselected angle between a strand and a reel.

With these and other objects in view, the present invention contemplates facilities for guiding a strand onto a reel wherein the strand guide reciprocates relative to the reel and a strand follower is carried by the strand guide, the position of the strand follower controlling the speed and direction at which the strand guide travels relative to the reel so as to constantly correct and maintain a preselected angle between the strand and the reel.

Other objects and advantages of the present invention will be apparent from the following detailed description when considered in conjunction with the drawings wherein:

FIG. 1 is a side view of a strand-distributing device embodying the principles of the invention;

FIG. 2 is a top view of FIG. 1 taken along the lines 2—2;

FIG. 3 is a view showing the details of a drive mechanism for the strand-distributing device of FIG. 1;

FIG. 4 is a sectional view of FIG. 2 taken along the lines 4—4;

FIG. 5 is a view showing the cooperative coaction of the elements of FIG. 4;

FIG. 6 is a view setting forth the cooperation of various elements of FIG. 4;

FIG. 7 is a bottom view of FIG. 4 taken along the lines 7—7;

FIG. 8 is a schematic of a hydraulic control system for the strand-distributing device of FIG. 1; and

FIG. 9 is a sectional view of FIG. 4 taken along lines 9—9.

Referring now in detail to the drawings and particularly to FIG. 1, a strand-distributing guide or carriage is generally indicated by the numeral 10. Rack 11 is attached to column 12 by collars 13. Carriage 10 reciprocates on the rack 11 so as to traverse reel 14. Carriage 10 carries the oppositely disposed sheaves 15 and 16 and the guide sheave 17. A strand 18 is taken up on or pulled from reel 14 and is guided onto or off of the reel 14 by sheave 17. A conventional core truck (not shown) rotates the reel 14 so as to pay the strand 18 onto the reel or acts as a brake when the strand 18 is pulled from the reel. Sheave 19 is provided for supporting a counterweight 20, as seen in FIG. 2. The counterweight 20 is attached to the carriage 10 by cable 21 and balances the carriage 10 so as to make it free wheeling on the rack 11. Guide 22 is provided for guiding the carriage 10 along the rack 11.

Turning to FIG. 2, the sheave 17, as shown, is a ring supported by bearings 25 on a frame 26. The frame 26 supports an oil motor 27 and strand follower 28. The oil motor 27 drives the carriage 10 on the rack 11.

As seen in FIG. 3, pinion 29 is driven by oil motor 27 through gear box 30 so as to displace the carriage 10 on the rack 11.

In FIG. 4 the principal features of the strand follower 28 are set forth in detail. The strand follower 28 has fingers 35 and 36 through which the strand 18 passes. The fingers 35 and 36 are carried by arm 37 and pivoted about pivot pin 38.

The position of the pivot pin 38 is determined by helix reverse cylinder 39. The helix reverse cylinder 39 has an internal shaft 40. On the lower end of the shaft 40, a stop 41 is provided which is retained on the end of shaft 40 by lock nut 42. A stop 43 is threaded onto the shaft 40 by threads 44. The stop 43 is restrained from rotation within the helix reverse chamber 39 while permitted free movement along the shaft 40. Threads 45 on the shaft 40 have the same direction as threads 44, but the pitch on threads 44 is twice that of threads 45.

The end member 46 of helix reverse cylinder 39 is threaded to accommodate the threads 45 of shaft 40 so as to retain shaft 40 concentrically within the internal chamber 47 of helix reverse cylinder 39.

Sleeve 48 is concentrically carried by shaft 40 so as to permit displacement of the sleeve 48 on shaft 40. The collar 49 is retained on the end of sleeve 48 by lock nut 50. The collar 49 is provided with a pivot pin 38 about which pin the arm 37 is permitted to pivot freely. A bushing 51 is provided to seal the end of the helix reverse cylinder 39 and to retain the shaft 40 and sleeve 48 concentric with chamber 47.

The displacement of the sleeve 48 on the shaft 40 and, therefore, the displacement of pivot pin 38, is limited by the distance between the stops 41 and 43. The distance between the stops 41 and 43 is adjusted by backing off lock nut 52 and cranking handle 53. For example, if the shaft 40 is advanced downwardly by handle 53, the stop 41 will also be carried downwardly by the shaft 40. As the pitch on threads 44 is twice the pitch of threads 45, the stop 43 will move upwardly the same distance stop 41 moves downwardly.

As seen in FIG. 1, when the stops 41 and 43 are closed as in FIG. 4, the pivot point 38 lies in the plane defined by the guide sheave 17. As the stops 41 and 43 are displaced equal distances apart by actuation of shaft 40, each stop is always positioned the same distance from the plane of the guide sheave 17 as the other stop.

The sleeve 48 is provided with an annular flange 54 which acts as a piston in the chamber 47. The piston or flange 54 is provided with a seal 55 to prohibit the flow of hydraulic fluid past the piston 54. As hydraulic fluid

is introduced into chamber 47 by port 56, the piston 54 will be forced upwardly within chamber 47 until sleeve 48 strikes stop 43 so as to shift pivot pin 38 upwardly. Hydraulic fluid on the opposite side of piston 54 exits through port 57.

As hydraulic fluid is introduced into chamber 47 by port 57, the piston 54 will be forced downwardly within the chamber 47 until nut 50 strikes stop 41 so as to shift pivot pin 38 downwardly. Hydraulic fluid on the opposite side of piston 54 exits through port 56. In this manner the pivot pin 38 may be displaced a predetermined distance in either direction as defined by the relative positions of stops 41 and 43. As each stop will be displaced the same distance from the plane defined by the guide 17 as the other stop, the pivot point 38 for a given setting of the stops 41 and 43 will always be displaced equal distances to either side of the plane defined by the guide 17.

FIG. 5 shows the pivot pin 38 displaced downwardly. The nut 50 striking the stop 43 limits the distance which the pivot pin 38 can be displaced.

FIG. 6 shows the pivot pin 38 displaced upwardly. The sleeve 48 slides on the shaft 40 until the sleeve 48 strikes the stop 41. The shaft 40 and stop 41 remain stationary as shown.

Returning to FIG. 4, a servovalve 61 is provided with a stem 62 which is pivotally attached to arm 37. The stem has a valve seat 63 which blocks the flow of hydraulic fluid into chamber 65 through inlet 64. As the stem 62 is displaced either upwardly or downwardly due to the strand follower being pivoted about pivot pin 38, the valve seat 63 will be carried with the stem 62 so as to permit the flow of hydraulic fluid into the chamber 65. The greater the displacement of the stem 62, the more hydraulic fluid will be permitted to flow into the chamber 65.

If, for example, the stem 62 is displaced upwardly, the hydraulic fluid will flow into chamber 65 from inlet 64 and will exit from chamber 65 through port 66. On the other hand, if the stem 62 is displaced downwardly, the hydraulic fluid will enter chamber 65 through inlet 64 and will exit through port 67. The stem 62 is also provided with the valve seats 68 and 69. As the stem 62 is displaced upwardly, valve seat 68 will be displaced to open port 70 so as to permit the flow of hydraulic fluid from chamber 65, which is trapped between valve seats 63 and 68, to exit through port 70. On the other hand, when valve stem 62 is shifted downwardly, seat 69 will be displaced downwardly to permit the hydraulic fluid in the chamber 65 lying between valve seats 63 and 69 to exit from chamber 65 through port 71.

Spring 72 maintains a constant tension on the valve stem 62 so as to urge the valve seat 63 into a neutral position, closing inlet 64. Therefore, the carriage 10 will not be displaced on the rack 11, unless a force is exerted on the strand follower 28 so as to unseat the valve seat 63. When valve stem 62 is displaced upwardly, seat 73 compresses spring 72; and when valve stem 62 is displaced downwardly, seat 74 compresses spring 72 so as to urge the valve seat 63 to close inlet 64. Weight 75 is provided to counterbalance the weight of the fingers 35 and 36.

FIG. 7 shows how the arm 37 is pivotally mounted on collar 49 by pivot pin 38. Valve stem 62 is pivotally attached to arm 37 by a similar pin arrangement. As the fingers are moved by the strand 18, the arm 37 will pivot on pivot pin 38 displacing valve stem 62 in the servovalve 61.

As seen in FIG. 8, the hydraulic control system of the strand guide 10 is schematically set forth. Pump 80 supplies hydraulic fluid to servovalve 61 through line 81. Depending on the direction in which valve seat 63 is displaced, the hydraulic fluid will exit from chamber 65 of servovalve 61 through either port 66 and line 82 or port 67 and line 83 to the carriage motor 27. Hydraulic fluid is supplied to the pump 80 from reservoir 84.

When hydraulic fluid is carried to the carriage motor 27 from the servovalve by way of line 82, the hydraulic fluid is routed back to the servovalve by line 83, and when hydraulic fluid is carried to the carriage motor by way of line 83, the hydraulic fluid is routed back to the servovalve by line 82. Hydraulic fluid, entering the servovalve from the carriage motor by way of line 82 and port 66, is returned to the reservoir 84 by line 79 through port 70; and hydraulic fluid, entering the servovalve from the carriage motor by way of line 83 and port 66, is returned to reservoir by line 79 through port 71.

The rate of flow of the hydraulic fluid through the carriage motor 27 controls the speed of the motor and, therefore, the rate at which the carriage 10 is displaced on the rack 11.

The direction in which the carriage 10 is displaced on the rack 11 is controlled by the direction the hydraulic fluid flows through the carriage motor 27. If the strand follower 28 is pivoted by the strand 18 about pivot pin 38 in a clockwise direction (FIG. 4), the valve seat 63 is displaced upwardly so that hydraulic fluid flows through servovalve 61 from inlet 64 to port 66. Line 82 carries the hydraulic fluid from port 66 to carriage motor 27 and line 83 returns the hydraulic fluid to the servovalve 61. The carriage motor 27 then rotates the pinion 29 counterclockwise (FIG. 3) to displace the carriage 10 downwardly on the rack 11. Pivot pin 38 is displaced upwardly (FIG. 6).

If the strand follower 28 is pivoted by the strand 18 about pin 38 in a counterclockwise direction (FIG. 4), the valve seat 63 is displaced downwardly so that hydraulic fluid flows through servovalve 61 from inlet 64 to port 67. Line 83 carries the hydraulic fluid from port 67 to carriage motor 27 and line 82 returns the hydraulic fluid to the servovalve 61. The carriage motor then rotates the pinion 29 clockwise (FIG. 3) to displace the carriage 10 downwardly on the rack 11. Pivot pin 38 is displaced downwardly (FIG. 5).

Hydraulic fluid is delivered to a helix reverse valve 86 by the pump 80 through line 87. The helix reverse valve 86 routes the hydraulic fluid to the helix reverse cylinder 39 through either line 88 or line 89. When the helix reverse cylinder 39 is supplied with hydraulic fluid from helix reverse valve 86 through line 88, the hydraulic fluid will enter the chamber 47 by port 57 forcing the piston 54 downwardly so as to displace pivot pin 38 downwardly; and when the helix reverse cylinder 39 is provided with hydraulic fluid from helix reverse valve 86 through line 89, the hydraulic fluid will enter chamber 47 through port 56 forcing the piston 54 upwardly so as to displace the pivot pin 38 upwardly. When hydraulic fluid is supplied through line 88, line 89 acts as an exhaust for the helix reverse cylinder, and when hydraulic fluid is supplied through line 89, line 88 acts as an exhaust for the helix reverse cylinder. The hydraulic fluid is returned from the helix reverse valve 86 to the reservoir 84 by line 90.

Referring to FIG. 9, fingers 35 and 36 are mounted on blocks 91 and 92, respectively. The blocks 91 and 92 are carried by the gears 93 and 94, respectively. The gears 93 and 94 are connected together by intermeshed gears 95 and 96. The gears 93, 94, 95, and 96 are mounted in the housing 97 of arm 37. In this manner the fingers 35 and 36 are displaced equal distances either toward or away from each other so as to accommodate for strands of different diameter. Screws 98 and 99 are provided for locking the gears 93 and 94 against rotation when the fingers are properly adjusted.

In Operation

Strand 18 is carried with carriage 19 by opposed sheaves 15 and 16 and guide sheave 17. The guide sheave 17 directs the strand 18 onto the reel 14 as the

carriage 10 reciprocates up and down on rack 11. The strand 18 is threaded from sheave 17 through fingers 35 and 36 of the strand follower 28 onto reel 14. The strand follower 28 is carried by the carriage 10.

If, for example, the carriage 10 is traveling downward in FIG. 1 and the reel 14 is being rotated to take the strand 18 up on the reel, the pivot pin 38 will be displaced upwardly as in FIG. 6 by helix reverse cylinder 39. Assuming for the moment that the carriage 10 is stationary, as the strand is laid on the reel 14, the strand will move downwardly exerting a force on the finger 35.

This movement of the strand 18 will, therefore, pivot the arm 37 clockwise about the pivot pin 38, and will displace the valve stem 62 of the servovalve 61 upwardly. As the valve stem 62 moves upwardly, the seat 63 will open inlet 64 so as to deliver hydraulic fluid to the motor 27 by way of line 82. As the hydraulic fluid passes through motor 27, pinion 29 is rotated counterclockwise to advance the carriage 10 downwardly on rack 11 so as to maintain the predetermined helix angle constant.

If the carriage 10 moves too rapidly, the arm 37 is pivoted counterclockwise, moving the valve seat 63 downwardly so as to restrict the flow of hydraulic fluid to motor 27, thereby slowing the carriage 10 down to the proper speed. Therefore, the speed of the carriage is determined by the position of the strand; and the helix angle is constantly corrected to properly lay the strand on the reel.

As the carriage 10 reaches the end of its travel, arm 100 will strike limit switch 101 (FIG. 1) reversing the helix reverse cylinder 39 so as to displace the pivot pin 38 downwardly, as in FIG. 5. As the reel 14 continues to turn, the strand 18 will start to move upwardly exerting a force against finger 36 of strand follower 28 so as to pivot the strand follower 28 counterclockwise (FIG. 4) about pivot pin 38. This directs hydraulic fluid from the servovalve 61 to the carriage motor 27 by way of line 83. Carriage motor 27 then rotates pinion 29 clockwise (FIG. 3) to displace the carriage 10 upwardly.

When the carriage reaches the end of its travel upward, the arm 102 will strike limit switch 103 (FIG. 1) to reverse the helix reverse cylinder 39 and displace the pivot pin 38 upwardly, as in FIG. 6. In this manner the angle which the strand makes with the reel will be constantly corrected so as to properly lay the strand on the reel.

The helix reverse cylinder 39 may be actuated in any conventional manner to displace the pivot point 38 and reverse the helix angle the strand makes with the reel. For example, the limit switches 101 and 103 can actuate solenoids 104 in a conventional manner to operate helix reverse valve 86 and reverse the flow of hydraulic fluid to the helix reverse cylinder 39 through lines 88 and 89. Such a conventional arrangement is shown in the British Patent 836,412 published June 1, 1960.

By adjusting the stops 41 and 43, any desired helix angle can be selected so as to lay the strand onto the reel in any desired manner. By adjusting the distance between the fingers 35 and 36, any diameter of strand can be properly laid on the reel.

Although the operation of the invention has been described for laying a strand onto the reel, it will be obvious to one skilled in the art that the application would be the same where the strand is being pulled from the reel.

By adjusting the position of the limit switches 101 and 103 on the guide 22, the travel of the carriage may be adjusted for different sizes of reels.

It is to be understood that the above-described arrangements of apparatus and construction of elemental parts are simply illustrative of an application of the principles of the invention and many other modifications may be made without departing from the invention.

What is claimed is:

1. In a device for constantly correcting the angle a strand makes with a reel:

a strand guide spaced a predetermined distance from the reel and mounted for displacement relative to the reel along a line parallel to the longitudinad axis of the reel,

means for displacing the strand guide relative to the reel,

a strand follower pivotally mounted between the strand guide and the reel for displacement with the strand guide, the pivot point of the strand follower being mounted for displacement along a line parallel to the longitudinal axis of the reel,

means for displacing the point about which the strand follower pivots equal distances on either side of the strand guide, the distance of the pivot point to either side of the strand guide determining the angle which the strand makes with the reel, and

means responsive to pivotal movement of the strand follower about its pivot point for controlling the means for displacing the strand guide to control the speed and the direction at which the strand guide is displaced relative to the reel.

2. In a device for constantly correcting the angle a strand makes with a reel:

a strand guide spaced a predetermined distance from the reel and mounted for displacement relative to the reel along a line parallel to the longitudinal axis of the reel,

means for displacing the strand guide relative to the reel,

a strand follower pivotally mounted between the strand guide and the reel for displacement with the strand guide, the pivot point of the strand follower being mounted for displacement along a line parallel to the longitudinal axis of the reel,

means for displacing the point about which the strand follower pivots equal distances on either side of the strand guide, the distance of the pivot point to either side of the strand guide determining the angle which the strand makes with the reel,

means responsive to pivotal movement of the strand follower about its pivot point for controlling the means for displacing the strand guide to control the speed and direction at which the strand guide is displaced relative to the reel, and

means responsive to the strand guide reaching the end of its travel for actuating the means for displacing the pivot point of the strand follower to displace the pivot point of the strand follower so as to reverse the angle which the strand makes with the reel.

3. A device for constantly correcting the helix angle between a strand and a reel:

a strand guide spaced a predetermined distance from the reel and mounted for displacement relative to the reel along a line parallel to the longitudinal axis of the reel,

means for displacing the strand guide relative to the reel,

a strand follower pivotally mounted between the strand guide and the reel for displacement with the reel, the pivot point of the strand follower being mounted for displacement along a line parallel to the longitudinal axis of the reel,

means for displacing the point about which the strand follower pivots equal distances on either side of the strand guide, the distance of the pivot point to either side of the strand guide determining the angle which the strand makes with the reel,

means for adjusting the means for displacing the point about which the strand follower pivots so as to control the distance from the strand guide which the pivot point of the strand follower may be displaced, and

means responsive to pivotal movement of the strand follower about its pivot point for controlling the means for displacing the strand guide for controlling

the speed and direction at which the strand guide traverses the reel.

4. In a device for constantly correcting the helix angle between a strand and a reel:

a carriage spaced a predetermined distance from the reel and mounted for displacement relative to the reel along the longitudinal axis of the reel,

a strand guide mounted on the carriage,

a strand follower pivotally mounted on the carriage and carried by the carriage between the strand guide and the reel, the pivot point of the strand follower being mounted for displacement along a line parallel to the longitudinal axis of the reel,

a reversible, hydraulically driven motor mounted on the carriage for displacing the carriage relative to the reel,

valve means for controlling the speed and direction of flow of hydraulic fluid to the reversible, hydraulically driven motor,

means responsive to pivotal motion of the strand follower for actuating the valve means,

a helix reverse cylinder for displacing the point about which the strand follower pivots equal distances on either side of the strand guide, the distance of the pivot point to either side of the strand guide determining the angle the strand makes with the reel, and

means for actuating the helix reverse cylinder to reverse the position of the pivot point on the carriage when the strand guide reaches the end of its travel so as to reverse the helix angle the strand makes with the reel.

5. In a device for constantly correcting the helix angle between a strand and a reel:

a carriage spaced a predetermined distance from the reel and mounted for displacement relative to the reel along a line parallel to the longitudinal axis of the reel,

a strand guide mounted on the carriage,

a strand follower pivotally mounted on the carriage and carried by the carriage between the strand guide and the reel, the pivot point of the strand follower being mounted for displacement along a line parallel to the longitudinal axis of the reel,

a reversible, hydraulically driven motor mounted on the carriage for displacing the carriage relative to the reel, the direction of flow of hydraulic fluid to the motor controlling the direction the carriage is displaced relative to the reel and the rate of flow of hydraulic fluid to the motor controlling the speed at which the carriage is displaced relative to the motor,

valve means for controlling the speed and direction of flow of hydraulic fluid to the reversible hydraulically driven motor,

means responsive to pivotal movement of the strand follower for actuating the valve means so that the direction which the strand follower pivots about its pivot point controls the direction of flow of hydraulic fluid to the reversible motor and the distance the strand follower pivots about its pivot point controls the rate of flow of the hydraulic fluid to the reversible motor,

means for displacing the point about which the strand follower pivots equal distances on either side of the strand guide, the distance of the pivot point to either side of the strand guide determining the angle the strand makes with the reel, and

means for changing the position of the pivot point on the carriage when the strand guide reaches the end of its travel so as to reverse the helix angle the strand makes with the reel.

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