July 23, 1946. G. H. ESCH 2,404,368

WINCH

Filed July 28, 1944 3 Sheets-Sheet 1

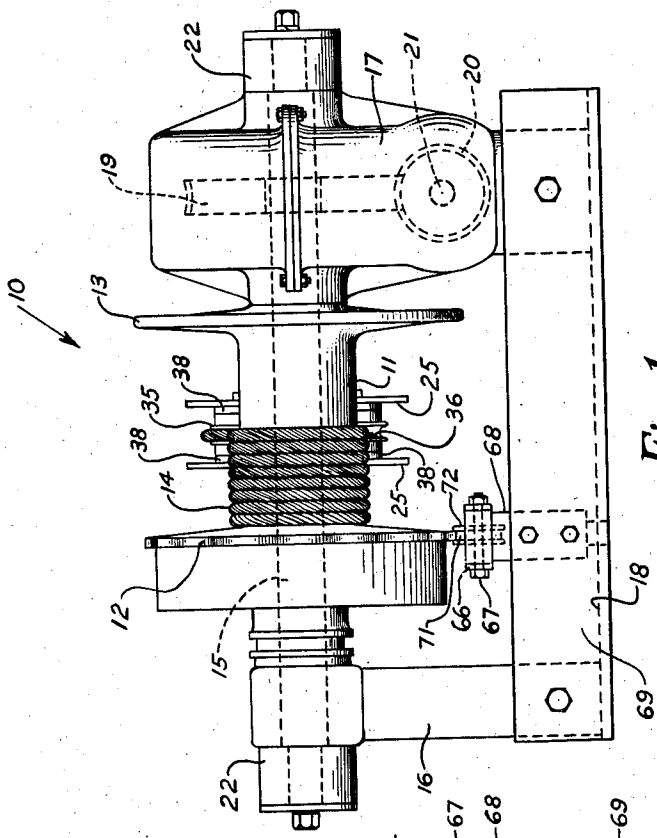


Fig. 1

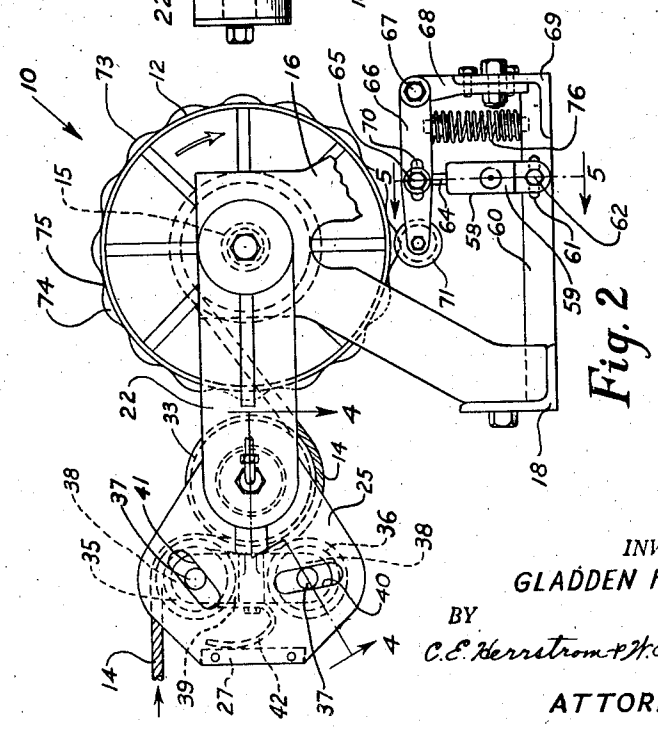


Fig. 2

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WINCH

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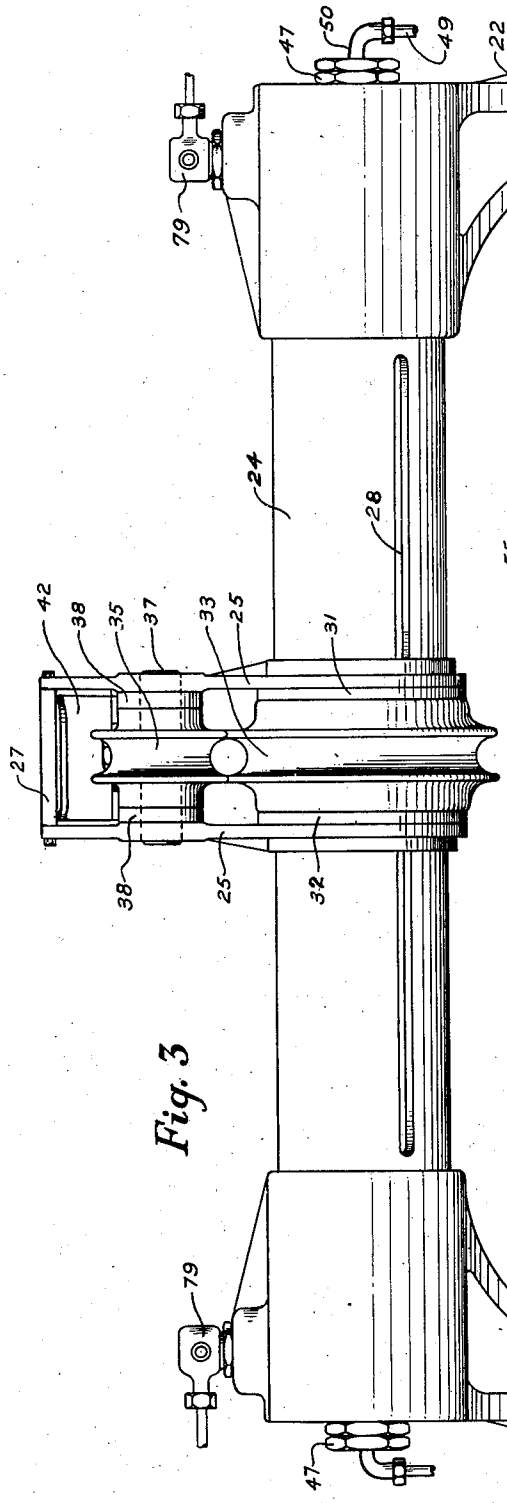


Fig. 3

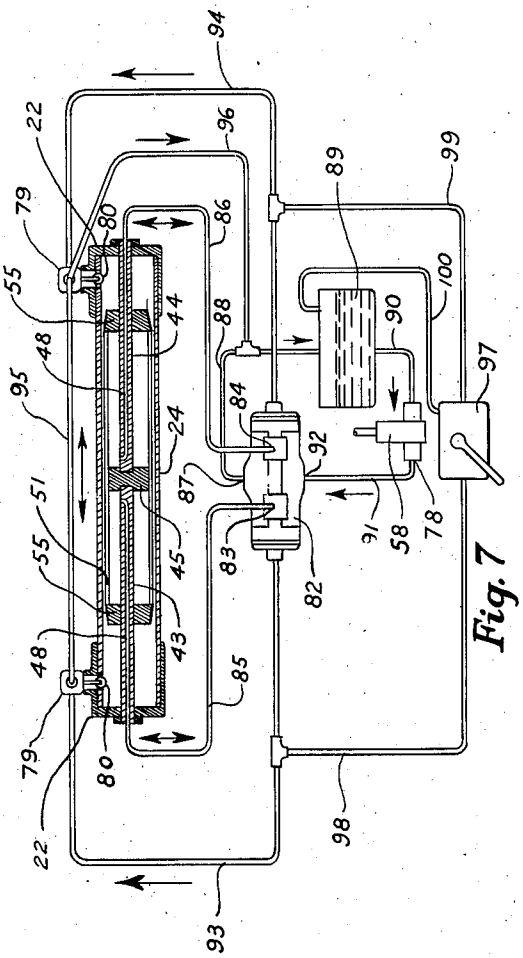


Fig. 7

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Filed July 28, 1944 3 Sheets-Sheet 3

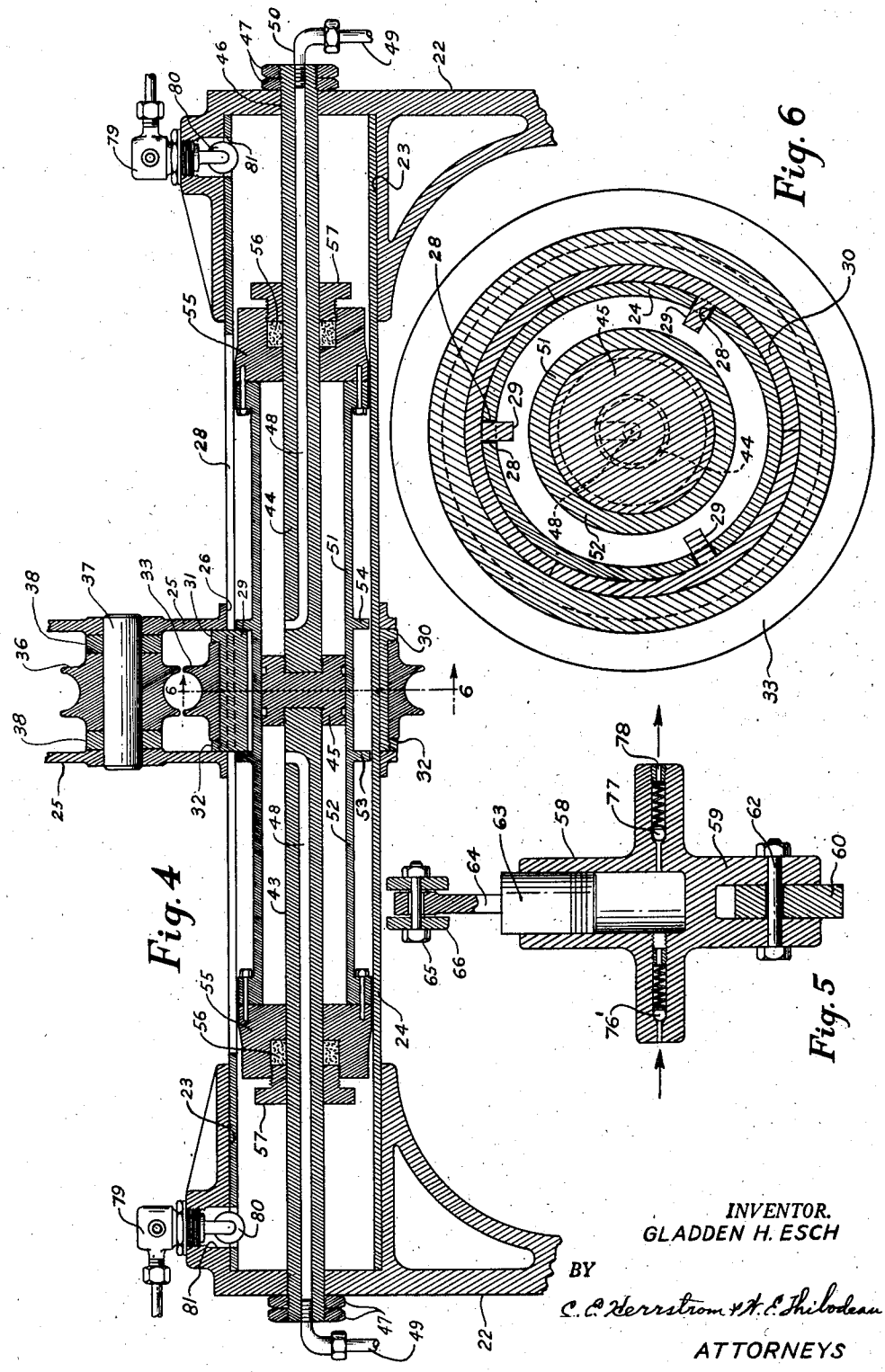


Fig. 4

Fig. 6

Fig. 5

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WINCH

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Application July 28, 1944, Serial No. 547,092

12 Claims. (Cl. 242—158)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates generally to winches, and has particular reference to a hydraulic level winding attachment for a winch.

It is an object of the present invention to provide a device for level winding a cable upon a drum in even layers.

A further object of the invention is to provide a device for level winding a cable upon a drum which is actuated hydraulically in timed relation to the rotation of the drum and which includes adjustable means for adapting the device to accommodate cables of various diameters.

Another object of the invention is to provide a compact level winding attachment for winches which is capable of accommodating a cable extending from the drum radially at any angle and which maintains the cable under tension during the winding thereof upon the drum.

Still another object of the present invention is to provide a reciprocable cable fairlead for level winding a cable upon a drum which is automatically reversed at opposite ends of the drum and, in addition, which may be reversed at any position when the direction of rotation of the drum itself is reversed.

Various mechanical devices have been proposed in the past for level winding cables upon drums, but these have not been entirely satisfactory due to the accumulation of errors therein and the necessary complexity of the design. In addition, the bulky size of these devices has made their use on portable winches prohibitive. These disadvantages are eliminated in the present device by providing a simple hydraulically actuated attachment which accurately guides the cable upon the drum in timed relation to the rotation of the drum. This is accomplished by means of a cable fairlead mounted upon a cylinder which, in turn, is reciprocable relative to a fixed piston. Reciprocation of the cylinder is effected by means of a positive displacement hydraulic pump actuated by a cam surface upon one flange of the drum of the winch. The cylinder and cable fairlead are carried by a frame pivotally mounted with respect to the drum, thus permitting the frame to be turned so that the cable can be led to the drum from any radial direction. Reversal of the cylinder and cable fairlead is effected by pilot valves positioned at opposite ends of the stroke of the cylinder and operable through a four-way

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valve to direct the fluid from the pump to the opposite end of the cylinder.

These and other objects of the invention will be made more apparent as this description proceeds, particularly when considered in connection with the accompanying drawings in which:

Figure 1 is a front elevation of a winch constructed in accordance with the present invention;

Figure 2 is an end elevation thereof, partly broken away;

Figure 3 is a plan view of a portion of the construction shown in Figure 1;

Figure 4 is a cross-section taken on the plane indicated by the line 4—4 of Figure 2;

Figure 5 is a cross-section taken on the plane indicated by the line 5—5 of Figure 2;

Figure 6 is a cross-section taken on the plane indicated by the line 6—6 of Figure 4; and

Figure 7 is a diagrammatical view of the hydraulic system.

Referring now more particularly to the drawings, it will be noted that in Figures 1 and 2 I have illustrated a conventional type winch 10, comprising a drum 11 having end flanges 12 and 13 and adapted to receive a cable 14. The drum 11 is mounted upon a shaft 15 having the opposite ends thereof journalled in bearings carried by the end bracket 16 and the housing 17, which are mounted upon the base 18. Keyed to the shaft 15 within the housing 17 is a worm wheel 19 meshing with a worm 20, the latter being carried by shaft 21 which is driven by any suitable means (not shown), such as from a power take-off shaft of a vehicle motor.

A pair of brackets 22 are pivotally mounted upon opposite ends of the shaft 15 and are each provided with a cylindrical bore 23 adapted to receive a sleeve 24 which, in turn, carries the cable guiding means to be described hereinafter.

Mounted upon the sleeve 24 are a pair of plates 25 provided with aligned openings 26 engageable with the outer periphery of the sleeve. It will be noted that the plates 25 are thus rotatably mounted on the sleeve 24 and, in addition, are slidable axially thereof. The radially outer ends of the plates 25 are detachably connected together by a plate 27.

The sleeve 24 is provided with three equally spaced longitudinally extending grooves 28, each of which is adapted to receive a radially inwardly extending key 29 formed upon the inner periphery of a split sleeve 30, journalled upon the sleeve 24. The sleeve 30 is formed in three sections to facilitate assembly and is provided at one end

with a radially outwardly extending flange 31 and is threaded at the opposite end to receive a nut 32. A sheave 33 is rotatably mounted upon the sleeve 30 and is retained thereon by means of the flange 31 and the nut 32. It will now be apparent that the sleeve 30 is adapted to be reciprocated longitudinally upon the sleeve 24 and carries the sheave 33 which is rotatable thereon.

In order to guide the cable 14 and to maintain a suitable tension thereon, I have provided a pair of sheaves 35 and 36 journalled upon shafts 37, which in turn are mounted between the opposite bifurcated ends 38 of a bracket 39 positioned between the plates 25. The opposite ends of the shafts 37 extend through the bifurcated ends 38 of the bracket 39 and are received and guided in slots 40 and 41 provided in the plates 25. Attached to the bracket 39, between the sheaves 35 and 36, is a leaf spring 42 having its opposite end in engagement with the inner surface of the end plate 27. With this construction, the bracket 39, carrying the sheaves 35 and 36, is resiliently urged toward the sheave 33 and functions to maintain the cable 14 under tension while the latter is being wound upon the drum and automatically releases the tension when the cable is being removed from the drum. This feature facilitates unwinding the cable from the drum, particularly when this is done by hand. It will be noted that the slots 40 and 41 are angularly disposed and cooperate with the shafts 37 to permit the necessary movement of the sheaves 35 and 36 under the action of the spring 42.

As best seen in Figure 2, in which the pivoted brackets 22 are extended rearwardly of the winch to guide the cable thereon from that direction, the cable 14 extends from the drum 11 around the lower side of the sheave 33, thence between the sheaves 36 and 33 and finally around the upper portion of the sheave 35 and outwardly therefrom for connection to the object being moved by the winch.

The novel arrangement hereinabove described maintains the cable under tension, thus permitting it to be wound evenly upon the drum and, at the same time, the entire cable guiding device can be swung around the axis of the drum 11 and the tension assembly supported by the plates 25 can be swung around the sleeve 24 to adapt itself to pull an object from any direction radially of the drum.

To permit the above described cable guiding means to be reciprocated axially of the drum 11 to level wind the cable thereon, I have provided the novel means hereinafter described.

With particular reference to Figure 4, 43 and 44 are piston rods mounted co-axially within the sleeve 24 and having their inner adjacent ends secured to the piston 45. The outwardly extending ends of the piston rods 43 and 44 extend through apertures 46 in the brackets 22 and are secured thereto by means of the locknuts 47. Each piston rod is provided with a longitudinally extending passage 48 therein having one end communicating with a tube 49 by means of the interconnecting elbow 50, and the opposite end extending through the wall of the piston rod in close proximity to the piston 45. The fixed piston 45 is positioned within a cylinder 51 received within the sleeve 24 and reciprocable relative to the sleeve and to the piston 45. In detail, the cylinder 51 has a body portion 52 provided with radially outwardly extending annular flanges 53 and 54 adapted to embrace the opposite ends of the keys 29 extending within the sleeve 24. It will now be apparent that the cylinder 51 is engageable with the cable guiding means in such a manner that the latter is reciprocated therewith. The opposite ends of the cylinder 51 are closed by suitable heads 55 through which extend the piston rods 43 and 44. A suitable packing 56 is provided within the heads 55 and is adapted to be compressed by the packing nuts 57 to prevent leakage between the cylinder and the piston rods.

Reciprocation of the cylinder 51 and the cable guiding means carried thereby is effected by means of a positive displacement pump 58, best shown in Figures 2 and 5. The pump 58 comprises a cylinder 59 having its lower end bifurcated and embracing the crossbar 60 of the base 18. The crossbar 60 is provided with a slot 61, and the cylinder is fixed to the crossbar by means of a clamping bolt 62 extending through the bifurcations of the cylinder and the slot in the crossbar. Received within the upper portion of the cylinder 59 is a piston 63 having a piston rod 64 slidably connected by means of a bolt 65 to a pair of arms 66, each having one end pivoted at 67 to a bracket 68 bolted to the vertically extending flange 69 of the base 18. The arms 66 are provided with slots 70 through which passes bolt 65, permitting reciprocation of piston rod 64. The opposite ends of the arms 66 embrace and pivotally support a cam follower 71 which engages the outer periphery of the flange 12 of the drum 11. Flanges 72 are provided on opposite sides of the cam follower 71 to maintain the follower in lateral alignment with the flange 12.

It will be noted from Figure 2 that the outer periphery of the flange 12 is formed with a cam surface 73 which comprises a pre-determined number of radially outwardly extending arcuate lands 74 with depressions 75 between adjacent lands. The coil spring 76 is mounted in compression between the cross arm 60 and arms 66 and maintains the cam follower 71 in constant engagement with the cam 73. With this construction it will be seen that rotation of the drum 11 and its flange 12 effects a reciprocation of the cam follower 71 and through the arms 66 a corresponding reciprocation of the piston 63 within the cylinder 59. The number of strokes of the piston per revolution of the drum 11 is dependent upon the number of the lands 74 provided on the cam surface 73 of the drum flange and the parts are proportioned so that the pump will deliver a pre-determined quantity of fluid for each revolution of the drum 11. Fluid is admitted into the cylinder 59 through the check valve 76' on the suction stroke of the piston and is forced from the cylinder through the check valve 77 on the downward stroke of the piston, at which time the check valve 76' automatically closes.

The outlet passage 78 of the cylinder is adapted by means to be more fully described hereinafter to communicate with the passage formed in one or the other of the piston rods 43 and 44 and with the interior of the cylinder 51 at the corresponding side of the piston 45. The construction is such that the quantity of fluid forced into the cylinder 51 from the pump 58 during one revolution of the drum 11 is an amount sufficient to move the cylinder 51 axially relative to the fixed piston 45 a distance equal to the width of the cable 14. Movement of the cylinder 51 is continuous during rotation of the drum 11 and moves the cable guiding means longitudinally at such a rate that the cable 14 is wound upon the drum 11 in even layers.

Adjustment can readily be made to enable the

axial movement of the cylinder 51 to exactly correspond to the width of the cable 14 and also to accommodate cables of various diameters. This is accomplished by moving the pump 58 laterally and clamping the cylinder 59 in various positions by means of clamping bolt 62 in the slot 61 in crossbar 60. This adjustment varies the effective length of the lever arm 66 and changes the length of the stroke of the piston 63, thus varying the amount of fluid transmitted to the cylinder 51 during each revolution of the drum.

When the cylinder 51 and the cable guiding means carried thereby have traversed the length of the drum 11 and the cable 14 has reached a position adjacent either to flange 12 or 13 thereof, provision is made for reversing the direction of reciprocation of the cylinder 51 to permit the cable guiding means to traverse the drum in the opposite direction and to thereby wind the cable 14 upon the drum in another layer. This reversing means comprises a pair of pilot valves 79 mounted in the brackets 22 and having actuating rollers 80 extending through openings 81 in the sleeve 24 and positioned for engagement with heads 55 attached to the cylinder 51 at opposite ends of the stroke of the latter. Actuation of one of the pilot valves 79 is operable to change the flow of fluid from the pump 58 to the opposite end of the cylinder 51, thereby reversing the direction of longitudinal movement of the cylinder.

Reference is now made to the hydraulic diagram shown in Figure 7, in which certain parts of the present device are illustrated diagrammatically for the purpose of showing the operation of the hydraulic system. 82 is a balanced, four-way, piston-type pilot-operated control valve of a conventional type. Valve 82 has ports 83 and 84 communicating by means of the tubes 85 and 86 respectively to the ends of the passages 48 provided in the piston rods 43 and 44. Outlet port 87 of the valve 82 communicates through tube 88 to the fluid reservoir 89. Tube 90 supplies fluid from the reservoir to the positive displacement pump 58, the outlet 78 of which communicates by means of a tube 91 to the inlet port 92 of the valve.

Operation of the valve 82 to reverse the flow of fluid to the cylinder 51 is effected by the pilot valves 79 which are connected to opposite ends of the valve 82 by the tubes 93 and 94. The pilot valves are adapted to be exhausted to the reservoir 89 by means of the tubes 95 and 96 which communicate with tube 88 leading to the reservoir. The pilot valves 79 are of conventional type and, when actuated by engagement with the cylinder 51 at one end of the stroke of the latter, operate to relieve the pressure at the corresponding end of the valve 82, thus automatically reversing the piston within the valve and reversing the direction of fluid flow. In detail, when cylinder 51 and the cable fairlead carried thereby are moving to the left of Figure 7, fluid from the pump 58 is directed by the valve 82 through the port 83 and the tube 85 to the interior of the cylinder at the left end thereof. At the same time, fluid from the right end of the cylinder 51 is exhausted through the tube 86 to the valve 82 and to the reservoir 89 through the tube 88. When the cylinder 51 reaches the end of its leftward stroke, the roller on the pilot valve 79 is engaged by the cylinder and the pressure on the left-hand end of the valve 82 is relieved through the tube 93 and exhausted through the pilot valve and the tubes 95, 96 and 88 to the reservoir 89. This reverses the valve

82 and fluid now flows from the pump 58 through the valve and out through the port 84 of the latter and through the tube 86 to the interior of the right-hand end of the cylinder 51. The interior of the left-hand end of the cylinder 51 now communicates through the tube 85 and the valve 82 to the exhaust tube 88 and is returned to the reservoir 89. When the cylinder 51 reaches the end of its right-hand stroke, the corresponding pilot valve 79 is engaged and actuated and relieves the pressure to the right-hand end of the valve 82 through the tube 94 and the exhaust tubes 96 and 88. This again reverses the valve 82 and, in this manner, reciprocation of the cylinder 51 is effected.

In the event the direction of rotation of the drum is reversed to permit the cable to be unwound from the drum after it has been wound thereon, or vice versa, there is provided a manually operated valve 97 connected by tubes 98 and 99 to the tubes 93 and 94 respectively, which in turn communicate with opposite ends of the valve 82. Actuation of the valve 97 is effective to relieve the pressure at either selected end of the valve 82 and to exhaust the same through the exhaust tube 100 to the reservoir 89. This reverses the valve 82 and reverses the flow of fluid to the cylinder 51 in a manner similar to the reversal effected by the pilot valves 79 and permits the longitudinal movement of the cylinder to be reversed at any time so that the cable guiding means will follow the winding or unwinding of the cable in the proper manner.

Although I have shown and described certain embodiments of my invention, it will be understood that I do not wish to be limited to the exact construction shown and described, but that various changes and modifications may be made as do not depart from the spirit and scope of my invention as defined in the appended claims.

What I claim is:

1. A device for level winding a cable on a drum comprising a member movable axially of the drum, cable guiding means carried by said member, hydraulic means arranged to move said member axially of the drum, and a cam on the flange of the drum arranged to actuate said hydraulic means in timed relation to the rotation of the drum.

2. A device for level winding a cable on a drum comprising a member reciprocable axially of the drum, cable guiding means carried by said member, a positive displacement hydraulic pump, means for actuating said pump in timed relation to the rotation of the drum to move said member axially of the drum to level wind the cable thereon, and means for adjusting the displacement of said pump to change the rate of movement of said member relative to the rate of rotation of said drum.

3. A device for level winding a cable on a drum comprising a member reciprocable axially of the drum, cable guiding means carried by said member, a positive displacement hydraulic pump, a cam for actuating said pump, said cam being movable in timed relation to the rotation of the drum to move said member axially of the drum to level wind the cable thereon, and means for adjusting the displacement of said pump to change the rate of movement of said member relative to the rate of rotation of the drum.

4. A device for level winding a cable on a drum comprising a cylinder element and a piston element, one of said elements being fixed and the other being reciprocable relative thereto, a cable

fairlead carried by the reciprocable element, a positive displacement hydraulic pump, a hydraulic conduit connecting said pump to the interior of said cylinder element, and a cam on the flange of the drum engageable with said pump to actuate the latter in timed relation to the rotation of the drum whereby fluid is forced from the pump into the cylinder element to move said cable fairlead to level wind the cable on the drum.

5. A device for level winding a cable on a drum comprising a cylinder element and a piston element, one of said elements being fixed and the other being reciprocable relative thereto, a cable fairlead carried by the reciprocable element, a positive displacement hydraulic pump, hydraulic conduits providing communication between said pump and the opposite ends of the cylinder element, means for actuating said pump in timed relation to the rotation of the drum, a valve for directing the flow of fluid from said pump to either end of the cylinder element, and a pair of pilot valves, said pilot valves being engaged by the reciprocable element at opposite ends of its reciprocation, connections between said pilot valves and the first mentioned valve to reverse the flow of fluid from the pump from one end of the cylinder element to the other end to reverse the movement of the reciprocable element and the cable fairlead to wind the cable on the drum in a plurality of layers, and independently operated means for reversing the reciprocation of the reciprocable element at any point in its travel.

6. A device for level winding a cable on a drum comprising a cylinder element and a piston element, one of said elements being fixed and the other being reciprocable relative thereto, a cable fairlead movable in accordance with the reciprocation of the reciprocable element, a positive displacement hydraulic pump, a hydraulic conduit between said pump and said cylinder element, a cam for actuating said pump, said cam being movable in timed relation to the rotation of the drum to move said reciprocable element and the cable fairlead to level wind the cable on the drum, and means for adjusting the stroke of said pump to change the rate of movement of the cable fairlead relative to the rate of rotation of the drum.

7. A device for level winding a cable on a drum comprising a member movable axially of the drum, cable guiding means carried by said member, hydraulically actuated means arranged to move said member axially of the drum, a pump having relatively reciprocable piston and cylinder elements, a cam follower associated with one of said relatively reciprocable elements, and a cam on the flange of said drum engageable with said cam follower to actuate said pump and move said cable guiding means in timed relation to the rotation of the drum.

8. A device for level winding a cable on a drum comprising a member movable axially of the drum, cable guiding means carried by said member, hydraulically actuated means arranged to move said member axially of the drum, a pump having relatively reciprocable piston and cylinder elements, a pivotally mounted lever connected to one of said relatively reciprocable elements, a cam on the flange of the drum, a cam follower carried by said lever and engageable with said cam, and resilient means acting on said lever to hold said cam follower in engagement with said cam so that rotation of the drum operates said pump and moves said cable guiding means axially of the drum in timed relation to the rotation of the drum.

9. A device for level winding a cable on a drum comprising a member movable axially of the drum, cable guiding means carried by said member, hydraulically actuated means arranged to move said member axially of the drum, a pump having relatively reciprocable piston and cylinder elements, a pivotally mounted lever connected to one of said relatively reciprocable elements, means associated with said drum for oscillating said lever in timed relation to rotation of said drum, and means for adjusting the location of the connection between the lever and the one of the relatively reciprocable elements attached thereto to vary the stroke of the pump to change the rate of movement of the cable guiding means relative to the rate of rotation of the drum.

10. A device for level winding a cable on a drum comprising a sleeve mounted with its axis parallel to the axis of the drum and having a longitudinal slot therein, a cylinder mounted for reciprocation within said sleeve, a piston within said cylinder, said piston being fixed relative to said sleeve, hydraulic means for reciprocating said cylinder, cable guiding means mounted on said sleeve for axial movement relative thereto, and means extending through the slot in said sleeve and connecting said cylinder and said cable guiding means so that reciprocation of said cylinder effects a corresponding reciprocation of said cable guiding means.

11. A device for level winding a cable on a drum comprising a sleeve mounted with its axis parallel to the axis of the drum, cooperating cylinder and piston elements concentrically mounted within said sleeve, one of said elements being fixed relative to said sleeve and the other being reciprocable relative thereto, a frame rotatably and slidably mounted on said sleeve, cable guiding means carried by said frame, means connecting said frame to said reciprocable element, and hydraulic means for actuating said reciprocable element to move said frame and cable guiding means axial of said sleeve.

12. A device for level winding a cable on a drum comprising a sleeve mounted with its axis parallel to the axis of the drum and having a plurality of circumferentially spaced longitudinal slots therein, a cylinder mounted for reciprocation within said sleeve, a piston within said cylinder, said piston being fixed relative to said sleeve, hydraulic means for reciprocating said cylinder, a frame rotatably and slidably mounted on said sleeve, sheaves carried by said frame arranged to guide the cable, and connecting means extending through said slots and engaging said cylinder and said frame so that reciprocation of said cylinder effects a corresponding reciprocation of said cable guiding means.

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