March 14, 1967 W. MULLER ET AL 3,309,064

WINCH MECHANISM WITH DUAL DRIVE

Filed Dec. 18, 1964 2 Sheets-Sheet 1

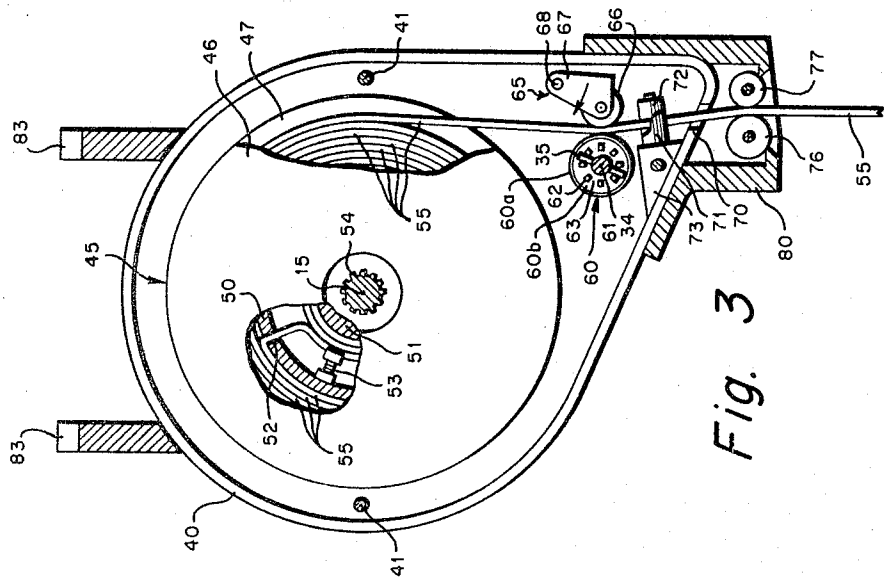


Fig. 3

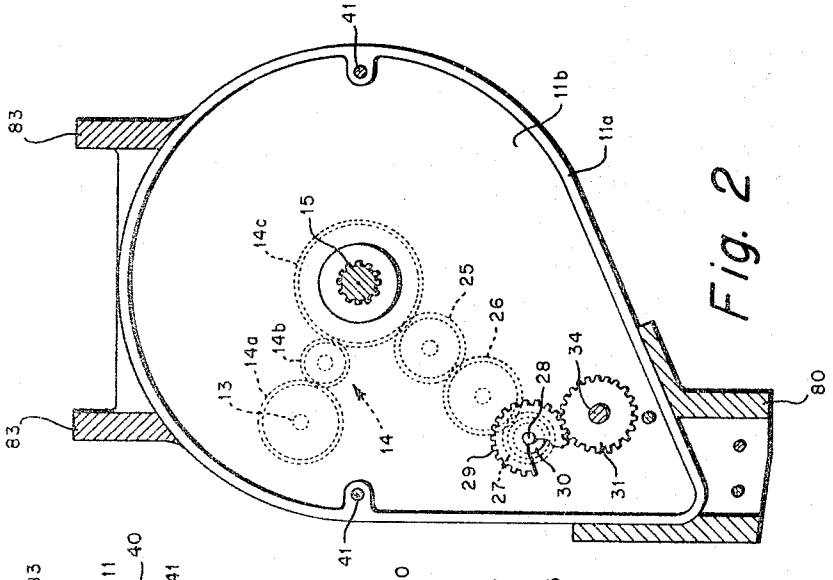


Fig. 2

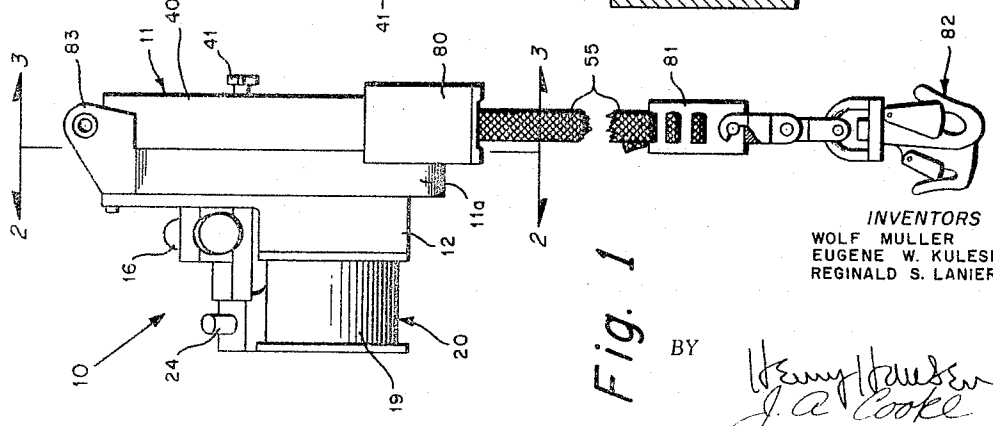


Fig. 1

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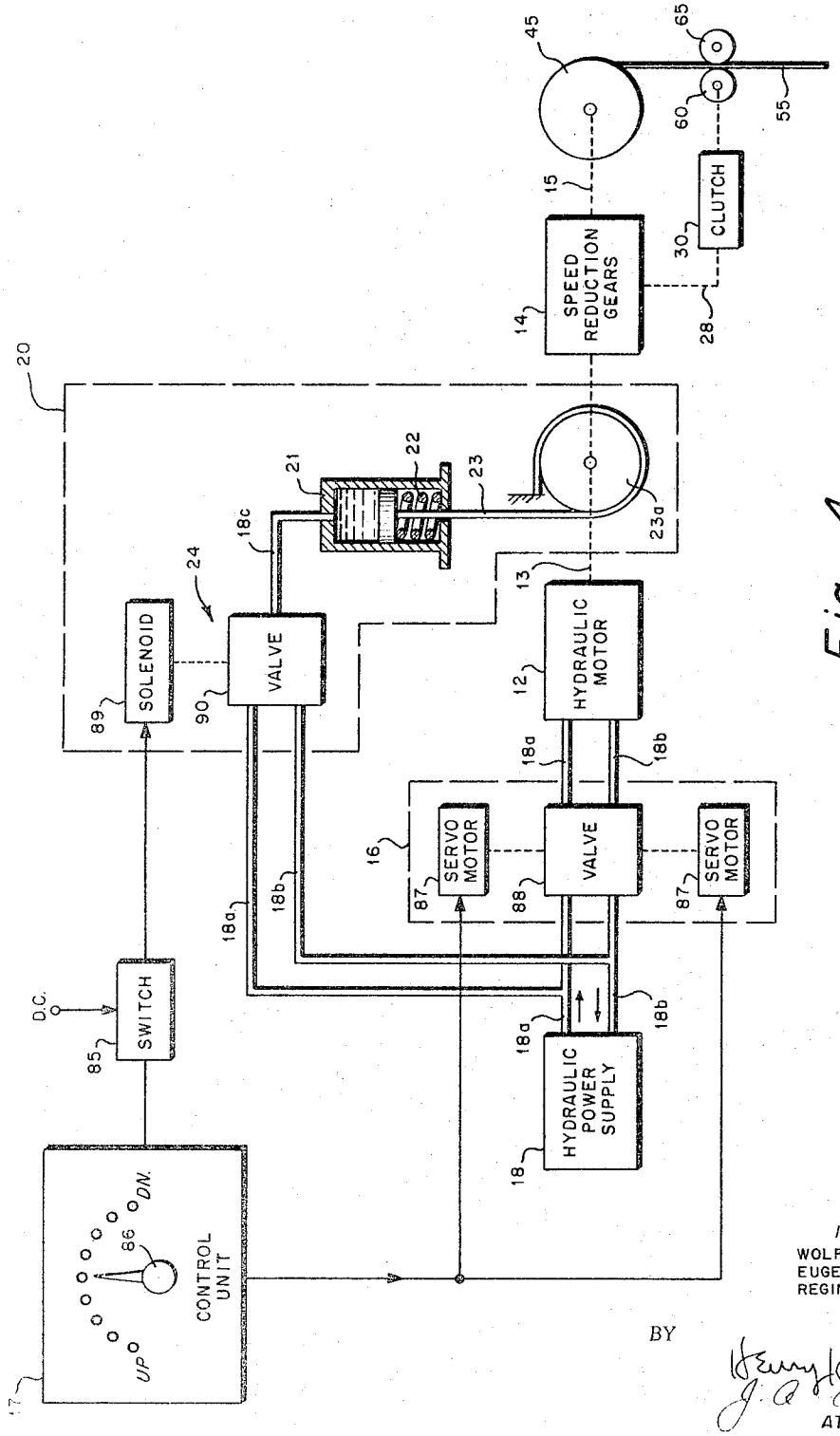


Fig. 4

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WINCH MECHANISM WITH DUAL DRIVE

Wolf Muller, New York, N.Y., Eugene W. Kulesh, Wayzata, Minn., and Reginald S. Lanier, deceased, late of Bal Harbour, Fla., by Doris L. Lanier, administratrix, Wayzata, Minn.; said Muller and said Kulesh assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

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6 Claims. (Cl. 254—168)

The present invention relates to a lightweight, remote controlled winch unit and more particularly to a new and improved winch unit which employs flat hoisting cable wound upon a replaceable tape reel assembly.

An increased reliance upon helicopters for military operations has created a need for a lightweight hoisting mechanism for raising and lowering cargo or other objects to and from the helicopter. Presently utilized hoisting mechanisms employ a standard drum type winch wherein the round cable is laid on in single or double rows. Each of the revolving drum units has associated therewith a level-wind mechanism for properly placing and spacing the cable on the drum. The level-wind mechanisms are important for purposes of precluding backlash and other malfunctioning which occur when the cable is inappropriately laid upon the drum. Great difficulty has been found in developing a level-wind mechanism which is sufficiently and accurately synchronized with the rotating drum, the difficulty in synchronism occurring by reason of the variation in drum diameter as the line or cable is paid in or paid out. As is readily seen, the mechanisms heretofore discussed are of large size and weight and therefore incompatible with the helicopter structure and dynamics wherein pay load and space are of high importance. In addition, the heretofore discussed hoisting apparatus is extremely complex with the attendant high possibility of fouling when paying out the cable from the winch and consists of a large number of parts operating at a high r.p.m. rate with the concomitant result of shorter operating life and high maintenance rate.

The general purpose of this invention is to provide a hoisting apparatus which embraces all of the advantages of similarly employed prior art devices and possesses none of the aforedescribed disadvantages. To attain this, the present invention contemplates a unique lightweight, remote controlled winch unit which uses flat cable wound upon a replaceable tape reel assembly which results in an extremely compact structure. These advantages are obtained with the use of a minimum of parts and a minimum of complex operating mechanisms.

An object of the present invention is to provide a lightweight hoisting apparatus for use with helicopters in raising or lowering cargo or other loads.

Another object is to provide a remote controlled winch unit consisting of few parts and operating at a low revolution per minute rate to thereby assure longer operating life, trouble-free performance and a minimum of maintenance.

A further object of the invention is the provision of a small, lightweight winch unit compatible with helicopter operations, operable under no-load conditions and free from the occurrence of backlash.

A still further object of the present invention is to provide a lightweight helicopter rescue winch mechanism which precludes fouling of the winch mechanism when paying out a belt or cable from the winch.

Yet another object of the present invention is the provision of a lightweight winch mechanism wherein the hoisting cable or belt is easily and quickly replaceable when so required.

Various other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features thereof will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawing:

FIG. 1 illustrates one view of a preferred embodiment of the invention;

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

FIG. 3 is a view taken along the line 3—3 of FIG. 1; and

FIG. 4 is a schematic representation of the hoisting system.

Referring now to FIGS. 1 and 4 for a general description of the hoisting mechanism of the present invention there is shown a winch unit generally noted at **10** including a housing assembly **11**, and a hydraulic motor **12** associated therewith. Hydraulic motor **12**, a commercial type known and used in the art, is a linear fluid displacement device particularly utilized for high torque applications with the direction of rotation being reversible instantly without backlash. The hydraulic motor **12** and an associated motor shaft **13** are utilized to drive, through speed reductors schematically represented at **14**, a spline shaft **15** which is more clearly illustrated in FIGS. 2 and 3.

The actuation and directional control of the hydraulic motor **12** is accomplished through a standard commercial electric servo valve assembly generally indicated at **16** and located on the hydraulic motor **12**. This servo valve assembly **16** is interconnected electrically to a remote control unit **17** located in either or both the cockpit or cargo areas of the helicopter. The remote control unit **17** is powered by the aircraft's 28 volt D.C. electric power supply source. In addition, the hydraulic motor **12** is apppropriately interconnected through the servo valve assembly **16** to an appropriate supply of hydraulic power such as the 1200 p.s.i. hydraulic power supply source **18** of the helicopter.

A brake housing **19** contains a band-type brake assembly **20** for the shaft **13** which is normally in a spring loaded or braked condition until fluid pressure in the brake cylinder **21** reaches and exceeds a preset and predetermined amount necessary to counteract the force of a spring **22** contained therein for releasing brake band **23** from drum **23***a*. A solenoid valve assembly **24** having electrical connection with the control unit **17** connects the brake cylinder **21** to either the pressure line **18***a* or the return line **18***b* of the hydraulic supply **18**.

Referring now to FIG. 2, the housing assembly **11** comprising a center housing **11***a* having the hydraulic motor **12** associated therewith. Contained within the center housing **11***a* and behind the plate **11***b* as viewed in FIG. 2 is the above-mentioned speed reduction gearing represented generally at **14**. Spur gear **14***a* secured to the motor shaft **13** drives the splined shaft **15** through the pinion gear **14***b* and spur gear **14***c* secured to the shaft **15**.

Appropriate gears noted at **25** and **26** are interposed between spur gear **14***c* and spur gear **27**, the latter gear being affixed to driving shaft **28**. Also secured to shaft **28** is a drive gear **29**. An overrun or unidirectional clutch **30** of conventional design is associated with the shaft **28** and interposed between the spur gear **27** and the drive gear **29** to operate the gear **29** in only one direction, that being in the payout direction discussed below. Drive gear **29** operatively engages spur gear **31** which is rigidly secured to rotatable shaft **34** appropriately journaled within housing **11***a*. A transverse driving pin **35** is rigidly secured to the end of shaft **34** for driving a milk-off roller **60** to be discussed below with reference to FIG. 3.

Referring now to FIG. 3, there is illustrated a reel housing generally indicated at **40** which when joined by fastener **41** to the center housing **11***a* forms an enclosure for reel assembly **45**. Fastener **41** may be of any conventional nature which effects a quick separation of the reel housing **40** and the center housing **11***a* to enable removal of the reel assembly **45** from the enclosure.

Reel assembly **45** includes a pair of reel plates **46** and **47** interconnected and spaced apart by compound hub elements **50** and **51** about which a flat cable **55** is wound. This cable **55** is constructed of woven or braided stainless steel wire and coated with polyurethane. The reel end of the cable **55** is wound about the inner hub **51** and is then passed through an aperture **52** formed in the outer hub **50**. The outer hub **50** then serves as the base about which the remaining cable is wound. The cable portion wound about the inner hub **51** is held in position by a spring-pressed retainer **53** interposed between the cable **55** and the inner hub **50**. The interior portion of inner hub **51** is formed with a splined socket portion **54** for receiving the splined shaft **15** and for transmitting the power therefrom to the reel assembly **45**.

In order to drive the cable from the reel under a no-load condition and to preclude bunching and fouling of the cable within the reel housing **40**, the winch unit **11** utilizes a milk-off roller **60** rotatable about a shaft **61** fixed to the reel housing **40**. Roller **60** is faced with rubber or other appropriate material at **60***a* to insure sufficient frictional engagement with the flat cable **55** when the roller engages the same. The transverse side face **60***b* of roller **60** is formed with a plurality of outwardly extending finger portions **62** having slots **63** formed therebetween for receiving the driving pin **35** which provides a unidirectional driving force to the milk-off roller **60**. The direction of rotation would be clockwise as viewed in FIG. 3.

Adjacent the milk-off roller **60** is a spring-loaded roller assembly generally noted at **65** for maintaining the flat cable in an abutting condition with the face **60***a* of the roller **60**. Assembly **65** includes a roller **66** rotatably secured to a pair of plates **67**, only one of which is shown, which in turn is pivotally secured through pin **68** to the reel housing **40**. Roller assembly **65** is spring urged to the position shown in FIG. 3 to insure positive engagement of the cable **55** with the milk-off roller **61**. It should be noted that when a load is applied to the flat cable **55**, the lateral force of the cable arising from the tendency thereof to assume a straight line will urge the roller assembly **65** against the spring and out of engagement with the roller **60**.

In order to preclude the cable from being destroyed by the chafing action of the cable against the side edges of the exit aperture **70** in the reel housing **40**, a pair of spaced side rollers **71** and **72** constructed of a thick, hard durometer rubber-like material are rotatably affixed to block **73** which in turn is rigidly secured to the reel housing **40**. Additionally, a pair of steel rollers **76** and **77** are rotatably journaled and housed within a collar member **80** which is welded or otherwise secured to the reel housing **40**. Whereas the resilient rollers **71** and **72** engage the side edges of the flat cable **55**, rollers **76** and **77** engage and guide the broad sides of the cable **55**.

The free end of the cable **55** is joined by an eye plate **81** to a rescue hook generally noted at **82**, the hook being of any convenient and appropriate design. Also, the winch unit **10** may be provided with brackets such as shown at **83** for mounting the same on the helicopter.

Referring now to FIG. 4, a remote control unit **17** is shown interconnected through switch **85** to an appropriate D.C. voltage supply from the helicopter or other appropriate source. A potentiometer **86** included within unit **17** provides the variable electrical power for operating the servo motors **87** which in turn mechanically control a servo valve **88** of the servo valve assembly **16**. Valve **88** in turn controls the direction and extent of fluid power

supplied from the hydraulic supply **18** to the hydraulic motor **12**. The output shaft **13** from the hydraulic motor **12** is further controlled by a braking system generally indicated at **20** which is self-energized when the hydraulic system pressure drops a predetermined amount below normal operating pressure. The brake is normally spring loaded by spring **22** until the fluid pressure in the brake cylinder **21** reaches and exceeds a predetermined force and counteracts the spring force thereby releasing the brake. A solenoid valve **90** connects the brake cylinder **21** to either the pressure line **18***a* or the return line **18***b* of the system. In case of hydraulic power failure, the pressure in the system drops, motor torque drops and the brake spring **22** actuates the brake. The solenoid **89** of assembly **24** is electrically connected to the source of D.C. power through the switch **85** and is so arranged that in case of electrical power failure, the valve **88** returns to null, the winch stops, the solenoid valve **90** turns off and connects the brake cylinder to the return line to bleed the cylinder and the brake is actuated.

In operation, when the operator actuates the potentiometer **86**, the servo motor **87** will actuate the valve **88** in a direction determined by the direction in which the potentiometer **86** is moved. The hydraulic fluid supply **18** supplies the power to operate the hydraulic motor **12** which in turn rotates shaft **13** and through the gear reduction mechanism **14** operates the reel **45** and milk-off roller **60**. The fluid supply is also fed through valve **90** to the brake cylinder **21** for disengaging the brake when the fluid pressure is at the operating pressure. This pressure is applied to the cylinder when the solenoid **89** is actuated by switch **85**, the solenoid connecting the cylinder to the pressure line **18***a*.

When the potentiometer **86** is moved to the down position, the milk-off roller **60** and reel assembly **45** will rotate in a clockwise direction as viewed in FIG. 3, with the roller **60** being arranged through the gear assembly to rotate at a speed sufficient to provide a continuous frictional pulling force to the flat cable irrespective of the position of the cable on the reel. By reason of this arrangement, bunching or fouling of the cable within the reel housing **40** is precluded. Under the condition wherein the milk-off roller **60** is attempting to pay out the cable at a greater speed than the reel speed would permit, a slipping condition will be effectuated with no deleterious effect.

When the potentiometer **86** is roated to the up position the hydraulic motor **12** causes the reel assembly **45** to rotate in a counterclockwise direction as viewed in FIG. 3. In this direction the clutch **30** is disengaged and the milk-off roller **60** is free running.

It will be understood that various changes in the details, materials, steps and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

What is claimed is:

1. A winch mechanism comprising:

a first open-ended housing,

a second mutually abutting open-ended housing substantially identical to said first housing and forming an enclosed container when placed in the abutting position, said second housing having an exit aperture formed thereon,

fastening means associated with said housings for releasably joining the same,

hydraulic motor means secured to said first housing and having a motor shaft extending within said first housing,

brake means secured to said first housing and operatively engaging said motor shaft,

a reel shaft rotatably secured to said first housing,

gear reduction means operatively engaging said motor shaft and said reel shaft,

a drive shaft journaled for rotation within said first housing and having driving means secured thereto,

gear train means operatively engaging said reel shaft and said drive shaft,

a reel unit for receiving a flat cable journaled for rotation within said second housing, said reel unit including a drive socket for operatively receiving said reel shaft,

roller means journaled for rotation within said second housing between said reel unit and said exit aperture for abutting engagement with the cable as the same passes through said exit aperture, said roller having means thereon for receiving said driving means,

and spring-biased means pivotally connected to said second housing for urging the cable into engagement with said roller means.

2. The winch mechanism of claim 1 wherein said gear train means includes a unidirectional clutch for rotating said drive shaft only in one direction.

3. The winch mechanism of claim 1 wherein said roller means is faced with rubber.

4. The winch mechanism of claim 1 wherein said driving means includes a transverse pin fixed to said drive shaft,

and said receiving means on said roller includes a series of outwardly projecting fingers having spaces therebetween for receiving said pin.

5. A winch mechanism comprising:

a base;

a bi-directional, variable speed hydraulic motor fixed to said base;

a first drive shaft axially extending from said base and operatively connected to said motor;

a second drive shaft axially extending from said base, spaced from said first drive shaft, and operatively connected to said motor;

a cable hub connected to said base for relative rotation in cable pay-out and cable pay-in directions and formed to removably and drivingly engage the extended end of said first drive shaft for rotation therewith;

a flat cable with one end thereof fixed to said hub and spirally wound about said hub upon itself;

a pair of cable-aligning means connected to said base, each means having a surface confronting the other and positioned normal to the axis of said hub and spaced from the other a distance substantially equal to the width of said cable for receiving the spirally wound portion of said cable therebetween;

first roller means spaced from the wound portion of said cable and connected to said base for rotation relative thereto;

second roller means connected to said base for rotation and positioned relative to said first roller means to urge a point along the paid out portion of said cable into frictional engagement with the periphery of said first roller means;

connecting means operatively connected between said second drive shaft and said first roller means for driving said first roller means to pay out said cable when said cable hub is being rotated in the pay-out direction;

servo-actuated valve means operatively connected to said hydraulic motor to control the direction and speed of rotation of said hydraulic motor;

a selectively positionable potentiometer operatively connected to said servo-actuated valve means to actuate said valve means;

hydraulically-actuated braking means fixed to said base and arranged to prevent rotation of said hydraulic motor; and

solenoid-actuated valve means operatively connected to both said hydraulically-actuated braking means and said potentiometer for actuating said bracking means to allow rotation of said motor when said potentiometer is in an actuating position.

6. A winch mechanism according to claim 5 wherein:

said cable is constructed of braided wire coated with polyurethane; and

the cable-engaging periphery of said first roller means is coated with rubber.

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