March 25, 1952 A. B. HULSE, JR 2,590,623

CONCENTRIC HELICAL DRUM DIFFERENTIAL WINCH

Filed April 23, 1949

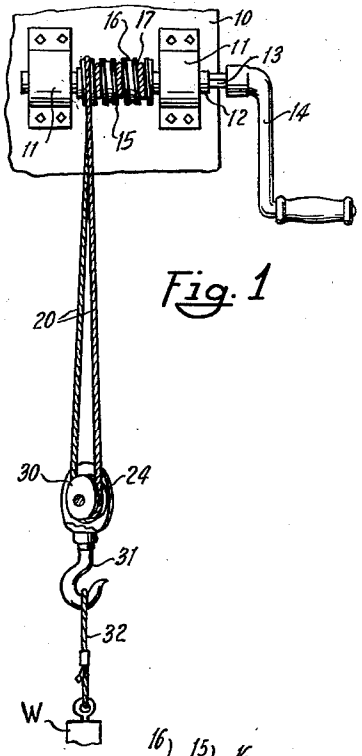


Fig. 1

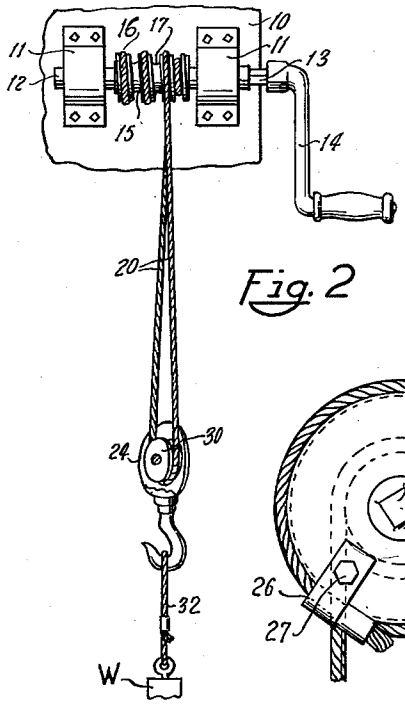


Fig. 2

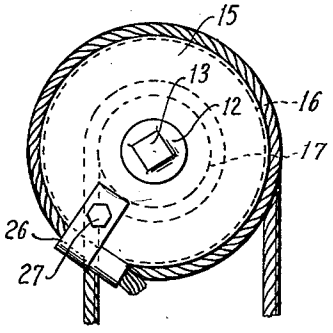


Fig. 4

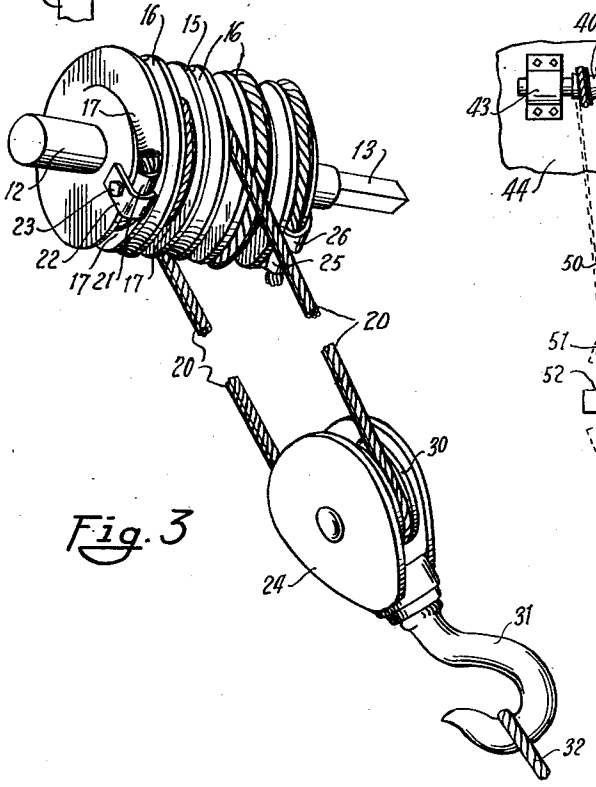


Fig. 3

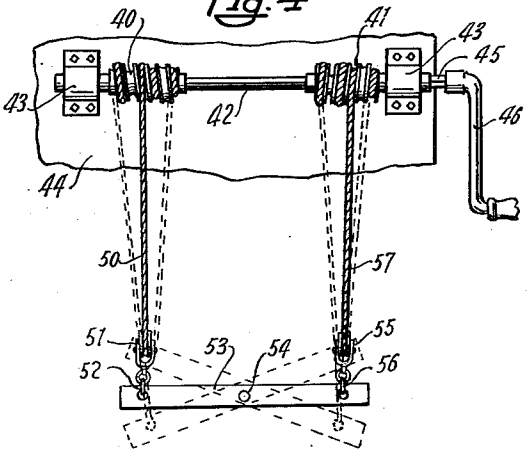


Fig. 5

Alexander B. Hulse, Jr.
INVENTOR.

BY Kastastings Adeley

ATTORNEY

Patented Mar. 25, 1952 2,590,623

UNITED STATES PATENT OFFICE

2,590,623

CONCENTRIC HELICAL DRUM DIFFERENTIAL WINCH

Alexander B. Hulse, Jr., Dallas, Tex.

Application April 23, 1949, Serial No. 89,237

11 Claims. (Cl. 254—167)

1

This invention relates to new and useful improvements in concentric helical drum differential winches.

It is one object of the invention to provide an improved differential drum winch for doing work requiring the application of a large force through a short distance of movement.

An important object of the inevntion is to provide an improved differential drum winch wherein the two drums of different diameters are provided in the form of concentric substantially co-extensive helixes of different diameter.

A further object of the invention is to provide a helical drum differential winch wherein the cables or lines are wound onto and off of the differential drums in substantially a plane perpendicular to the axis of said drum.

Another object of the invention is to provide a helical drum differential winch of the character described wherein the cables or lines wound on the differential drums enter or leave the helical grooves of the different drums at a point spaced substantially 180 degrees from each other in substantially a plane vertical to the longitudinal axis of the drums, whereby side sway and misthreading of the cables or lines is substantially eliminated and the force applied by the winch is increased.

Still another object of the invention is to provide a plurality of concentric helical drum differential winches mounted on the same shaft and operating in opposite directions, whereby a controlled force may be applied to work in opposite directions by said winches.

A still further object of the invention is to provide a concentric helical drum differential winch which is particularly adapted for use as a source of power for operating shearing machines, arbor presses, punch presses, tree pruners, steering devices, lifting devices, and the like.

Still another object of the invention is to provide a concentric helical drum differential winch which is compact and simple in construction and economical to manufacture.

Additional objects and advantages of the invention will readily be apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a view in elevation of a helical drum differential winch constructed in accordance with the invention and showing the movable pulley and cable in extended position,

Figure 2 is a view similar to Figure 1 showing the cable and pulley in a contracted position,

2

Figure 3 is an enlarged isometric view of the helical differential drum and movable pulley,

Figure 4 is an enlarged end view of the helical differential drum and cable wound thereon, and

Figure 5 is a plan view of a double helical drum differential winch and showing the same acting upon a pivoted member to move the member in opposite directions.

In the drawings, the numeral 10 designates a base member or support, which may form a part of a machinery frame, a building or any other suitable stationary or fixed structure. Mounted on the base member are a pair of spaced bearing members 11 carrying an elongate shaft 12 which is rotatable in said bearing blocks. The end of the shaft is formed with a square 13 upon which a crank 14 is removably mounted for turning the shaft. While a crank has been shown as the means for rotating the shaft 12, it is obvious that any other source of power, such as a motor or the like, may be used for that purpose.

On the shaft 12 between the bearing members is located a helical differential drum member 15 which is preferably in the form of a concentric substantially co-extensive pair of grooved helical drum members of different diameters. The helical differential drums are in substantially the form of a single thread worm, the larger drum being formed by the outer grooved faces 16 of the helical thread, and the smaller helical drum being formed by the inner grooved roots 17 of said thread.

An elongate flexible cable 20, which may be in the form of a flexible wire rope, wire, cord, chain, rope or any other suitable flexible material, and which will be hereinafter referred to as a cable, has one end 21 affixed in the root groove 17 at one end of the drum member by means of a clip 22 held in place by a screw 23, as clearly shown in Figure 3. The cable is then wound in such root groove 17 to substantially the opposite end of the differential drum member 15, and then extends outwardly therefrom a substantial distance and is bent around a movable pulley block 24 and then back to the differential drum member, where its other end 25 is secured by means of a clip 26 and bolt 27 in the large outer groove 16 of the differential drum member.

The end of the cable which is mounted in the large outer drum groove 16 is so affixed that the cable is directed around the helical groove of the outer drum in the opposite direction from the portion of the cable which is in the inner smaller drum groove 17, as clearly shown in Figures 3 and 4. It will be seen, therefore, that as the drum is rotated by the shaft 12 the cable will be wound

off of one of the drum grooves and onto the other, the cable being wound onto one drum groove at a point spaced substantially 180 degrees around the drums from the point at which the cable is wound off of the other drum groove.

Since the cable leaves one groove at a point substantially 180 degrees around the periphery of the drums from which the cable enters the other groove and the pitches of the two grooves are substantially the same, it will be seen that the points of entry and egress of the cable in the grooves are approximately one-half turn of the thread apart, so that one portion of the cable leaves the larger drum groove in substantially the same plane vertical to the longitudinal axis of the drums as the other portion of the cable enters the smaller drum groove. Also, if the diameter of the groove of the sheave **30** of the movable pulley **24** is substantially the same as the diameter of the root groove **17** plus one-half the difference between the diameters of the root groove and the outer tooth groove **16**, the cable sections extending from the differential drums will be substantially parallel to each other. Such structure and disposition of the cables provides maximum application of force to the movable pulley by eliminating angular components which would reduce the transmission of force from the drums to the pulley.

The movable pulley **24** is suitably connected in some means to the work or load which is to be moved by the winch. As shown in the drawings, the pulley is provided with a swivel hook **31** which has a rope or cable **32** engaged therewith, said rope supporting a load or weight W. Obviously, however, the pulley may just as well be connected with a lever arm or any other movable member to which it is desired to apply force to cause movement of such member.

It will be seen that when the differential drum member **15** is rotated, by means of the shaft **12** on which it is mounted, so that the cable **20** is wound in the smaller drum groove **17** as shown in Figure 1, the length of cable wound around such smaller helical drum groove is shorter than would be the length of cable wound in the larger outer drum groove **16**. Therefore, when the cable is wound in the smaller drum groove, the pulley **24** is spaced the greater distance from the differential drums of the winch and is in the extended position. However, when the drums are turned in the opposite direction to wind the cable in the larger helical drum groove **16**, the length of cable wound around such helical drum is greater than was the length of cable which was in the smaller drum groove **17**, so that the portions of the cable extending from the drums to the pulley **24** are reduced in length and the pulley is moved toward the helical differential drums to lift the weight W or to move a lever connected to the pulley toward the drum.

It will be seen that as the drums are turned through one revolution, the pulley **24** will be moved toward or from the drum a distance equal to one-half the difference between the helical distance around one turn of each groove. This is true because the length of the cable extending outwardly from the drum toward the pulley is increased or decreased during such single revolution of the drums by an amount equal to the difference between the helical distance around the larger groove and the helical distance around the smaller groove. However, due to the double lines extending around the pulley sheave **30**, the pulley will move only one-half such distance.

The distance of movement of the pulley is therefore a function of the difference in root diameters of the two grooves, and the mechanical advantage to be gained is the distance traversed by the applied force at the crank in one revolution divided by one-half the difference between the distances around the two grooves in one revolution.

In Figure 5, a modified form of the invention is shown, wherein a pair of oppositely acting concentric helical drum differential winches are mounted on a single shaft and are operatively connected to opposite ends of a centrally pivoted lever for causing positive movement of the lever in either direction. This form of the invention is particularly adapted for use in devices wherein the lever must be positively moved in each direction, as for example a marine steering apparatus, or the like.

Such modified form of the winch includes a helical differential drum member **40** wherein the turns of the helical drums are in the form of a right hand thread, and a similar helical differential drum member **41** having its helical grooves directed in the form of a left hand thread. The drum members **40** and **41** are mounted in spaced relationship on a single shaft **42** which is mounted at its outer ends in bearing members **43** carried by a base or support member **44**. One end of the shaft is provided with a square extension **45** upon which a crank handle **46** is removably positioned for turning the shaft, though, obviously, the shaft may be turned by other means than the crank, such as a motor or the like.

The cable **50** on the drum member **40** extends outwardly from the drum member and is bent around a pulley **51** having a swivel eye **52** connected in an opening at one end of an elongate lever member **53** which pivots at a shaft **54** at substantially the center of the lever. The other end of the lever likewise has a pulley **55** connected thereto by a swivel eye **56**, and the cable **57** from the left hand helical differential drum member **41** extends around the sheave of the pulley **55**. The cables **50** and **57** are so wound on the drum members **40** and **41** that the lever **53** may be moved in either direction by movement of the pulleys caused by the winch action of the differential drum members.

Since the worm threads which form the helical grooves of the drum members are directed in opposite directions, it will be seen that as the shaft **42** is turned in one direction, the cable **50** will be wound onto the larger drum groove of the drum member **40**, while the cable **57** will be wound onto the smaller drum groove of the drum member **41**. Likewise, when the shaft is turned in the opposite direction the cable **50** will be wound off of the larger drum groove and onto the smaller drum groove of the drum member **40**, while the cable **57** will be wound off the smaller drum groove onto the larger drum groove of the drum member **41**. Thus the lever member **53** may be moved in either direction about the central pivot **54**, as shown in dotted lines in Figure 5.

Since the diameters of the larger drum grooves of each of the drum members **40** and **41** are substantially identical and the diameters of the smaller drum grooves of said drums are likewise substantially identical, it will be seen that the cables **50** and **57** will be maintained taut, and movement of the cables causing corresponding movement of the pulleys at the outer ends of the cables will be uniform and equal with respect to each drum member, so that a positive force is ap-

plied to the lever at all times and in both directions.

The structure and operation of the helical drum members 40 and 41 are the same as those of the form first described, the only difference being that the drum member 40 is provided with a right hand thread, while the other drum member 41 is provided with a left hand thread. It will further be seen that such arrangement of the helical drum members causes the cables to move uniformly with respect to each other when the drums are turned. For example, when the drums are turned in one direction to wind the cable 50 onto the large drum groove of the drum member 40, the cable sections will move toward the right hand end of such drum member, and simultaneously the cable 57 will be wound into the smaller drum groove of the drum member 41 and will move toward the left hand of such drum member, whereby the pull on the lever member will be substantially balanced. Likewise, when the drums are turned in the opposite direction, the cable sections will move toward the opposite ends of the drum members and the pull on the lever will continue to be substantially balanced.

If the shaft 54 is connected, for example, to the rudder of a boat, it will be seen that the double winch mechanism provides for a positive application of amplified forces to the lever arms to positively swing the rudder in either direction. Also, since the actions of the drums oppose each other, the lever 53 will be positively held in adjusted positions.

It is believed to be readily apparent that the mechanical advantage obtained by the differential helical drums may be increased in value by reducing the difference between the diameters of the two drum grooves. Thus, if the smaller drum groove 17 is formed with a diameter more nearly approaching the diameter of the larger drum groove 16, it will be seen that a shorter length of cable will be payed off or wound upon the drums as they are rotated, thus applying a greater force over a shorter period of movement of the movable pulley. Furthermore, it is believed to be readily apparent that by multiplying or compounding the pulley arrangement, an increased force may be transmitted to the movable pulley. This result can be obtained by affixing a stationary pulley to the base or support member 10 and a double sheave in the movable pulley, and then looping the cables about the sheaves of the movable pulley and the stationary or fixed pulley, in the well-known customary manner of compounding pulleys, to obtain a further amplification of force delivered at the movable pulley.

It is also believed to be manifest that the number of differential drums acting upon a single work member may likewise be multiplied. Thus, two or more drum members having the same helical thread direction provided thereon may be mounted on a single shaft and the cables from such drums may be directed to a pair of sheaves in a single pulley so that both drums will act on the single pulley. It is also believed manifest that any other suitable arrangement of the drum winches may be used to obtain a desired result.

From the foregoing, it will be seen that an improved differential drum winch has been provided having a drum member with two drums of different diameters in the form of concentric substantially co-extensive helixes of different diameter, and that a cable is wound on the drum member in such a manner that the sections of the cable acting upon the movable pulley enter and leave their respective drum grooves in substantially a plane perpendicular to the axis of said drums, and that such arrangement provides for the application of maximum force by the drum winch. Since the cable sections enter and leave the drum grooves of the helical differential drum member in substantially a plane vertical to the axis of the drum, it will be seen that the cable may move from one end of the drum member to the other without danger of misthreading of the cable, so that the cable will remain in the proper drum grooves at all times. It will further be seen that the concentric substantially co-extensive helical differential drums of the drum member provide a compact simple construction having an improved winch action. Likewise, it is believed readily apparent that the helical differential drum winch of the invention is particularly adapted as a source of power for operating various types of machinery or the like requiring the application of a large force over a short distance.

It will particularly be noted that a winch has been provided having a plurality of concentric helical drum differential winches mounted on the same shaft and operating in opposite directions, whereby a controlled force may be applied to work in opposite directions by the winches to cause positive controlled movement of the work in either direction.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. In a differential drum winch of the type wherein a flexible cable has its opposite ends secured to the drum and a loop between its ends extending outwardly from the drum, the improvement which includes, a cylindrical drum member rotatable upon its longitudinal axis, and a pair of substantially co-extensive concentric helical grooves of different diameters on said drum member for receiving the ends of the flexible cable.

2. In a differential drum winch of the type wherein a flexible cable has its opposite ends secured to the drum and a loop between its ends extending outwardly from the drum, the improvement which includes, a drum member rotatable upon its longitudinal axis, a helical groove extending substantially from end to end of said drum member, and a second helical groove having a diameter greater than the first helical groove also extending substantially from end to end of said drum member, said helical grooves being spaced one-half turn apart longitudinally of the drum member and adapted to receive the ends of the cable.

3. A differential drum winch including, a cylindrical drum member rotatable upon its longitudinal axis, a pair of co-extensive concentric helical grooves of different diameters on said drum member, and a cable having one end secured in one of the helical grooves at one end of the drum member and wound in said groove toward the other end of the drum and having its other end secured in the other helical groove at the other end of said drum member and wound in said groove in a direction opposite that of the first mentioned end of said cable, said cable having a loop between its ends extending outwardly

from the drum member and wherein the sections of the loop leave the grooves of the drum member on substantially diametrically opposite sides of said drum member in substantially a plane transversely of the axis of said drum member.

4. A differential drum winch including, a cylindrical drum member rotatable on its longitudinal axis, a pair of co-extensive concentric helical grooves of different diameters on said drum member, a movable pulley spaced laterally from said drum member, and a cable threaded around the pulley and extending from said pulley to the drum member, one section of said cable being engaged in one of the helical grooves of the drum member and wound thereon toward one end of the drum member and having its end secured at such end of the drum member, the other section of said cable entering the other groove of said drum member on the opposite side of the drum member from said first section and being wound in said other groove in a direction opposite said first mentioned section toward the opposite end of the drum member and having its end secured in said groove at said opposite end of the drum member.

5. A differential drum winch including, an elongate cylindrical body, an external projecting helical flange member extending substantially from end to end of said body and having a helical groove formed in its outer helical surface, and a flexible cable having one end wound on the cylindrical body and its opposite end wound in the helical groove of the flange member and having a loop between its ends extending outwardly from the body and flange member.

6. A differential drum winch including, an elongate cylindrical body, an external helical flange member extending substantially from end to end of the cylindrical surface of said body and having a helical groove formed in its outer helical surface, the adjacent turns of said flange member being spaced apart longitudinally of the body a distance substantially equal to the thickness of said flange member, and a flexible cable having one end wound on the cylindrical body between the turns of the flange and its opposite end wound in the helical groove of the flange member and having a loop between its ends extending outwardly from the body and flange member.

7. A drum member for a differential drum winch of the type wherein a flexible cable has its opposite ends secured to the drum and a loop between its ends extending outwardly from the drum and including, an elongate cylindrical body, a helical groove extending substantially from end to end exteriorly of said cylindrical body, and a helical flange member also extending substantially from end to end of said body and disposed between the turns of the helical groove on said body, said helical flange having a helical groove formed in its outer helical surface, the grooves in the body and the flange member being disposed to receive the opposite ends of the flexible cable.

8. A differential drum winch including, a base member, a drum member carried by the base member and rotatable about its longitudinal axis; a pair of co-extensive concentric helical grooves of different diameters on said drum member, and

a cable having one end secured in one of the helical grooves at one end of the drum member and wound in said groove toward the other end of the drum and having its other end secured in the other helical groove at the other end of the drum member and wound in said groove in a direction opposite that of the first mentioned end portion of said cable, said cable having a loop between its ends extending outwardly from the drum member on opposite sides of and disposed in substantially a plane extending transversely of the axis of the drum member.

9. A differential drum winch of the character set forth in claim 8 and including, a movable pulley spaced laterally from the drum member and engaging the loop of the cable, said pulley being moved toward and from the drum as said drum is rotated to wind the cable from one groove into the other.

10. A differential drum winch including, a shaft, a pair of drum members mounted on said shaft in spaced relationship, a pair of helical grooves of different diameters on one of said drum members, a first cable having one end secured in one of the helical grooves at one end of said one drum member and wound in said groove toward the other end of said one drum member and having its other end secured in the other helical groove at the opposite end of said one drum member and wound in said groove in a direction opposite that of the first mentioned end of the cable, said cable having a loop between its ends extending outwardly from said one drum member on opposite sides of and in substantially a plane transversely of the axis of said one drum member, a pair of helical grooves of different diameters on the other drum member, and a second cable having one end secured in one of the helical grooves at one end of said other drum member and wound in said groove toward the other end of said other drum member and having its other end secured in the other helical groove at the opposite end of said other drum member and wound in said groove in a direction opposite that of the first mentioned end of the cable, said cable having a loop betweeen its ends extending outwardly from said other drum member on opposite sides of and in substantially a plane transversely of the axis of said other drum member.

11. A differential drum winch of the character set forth in claim 10 wherein, the helical grooves formed on one of the drum members extend therearound in a right hand direction, and the grooves formed in the other drum member extend therearound in a left hand direction, whereby the cables connected with said drums operate in opposite directions upon rotation of the shaft in a single direction.

ALEXANDER B. HULSE, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
32,767	Graham et al.	July 9, 1861
413,389	Cruikshank	Oct. 22, 1889
1,810,910	Esmond	June 23, 1931
2,189,447	Martin	Feb. 6, 1940