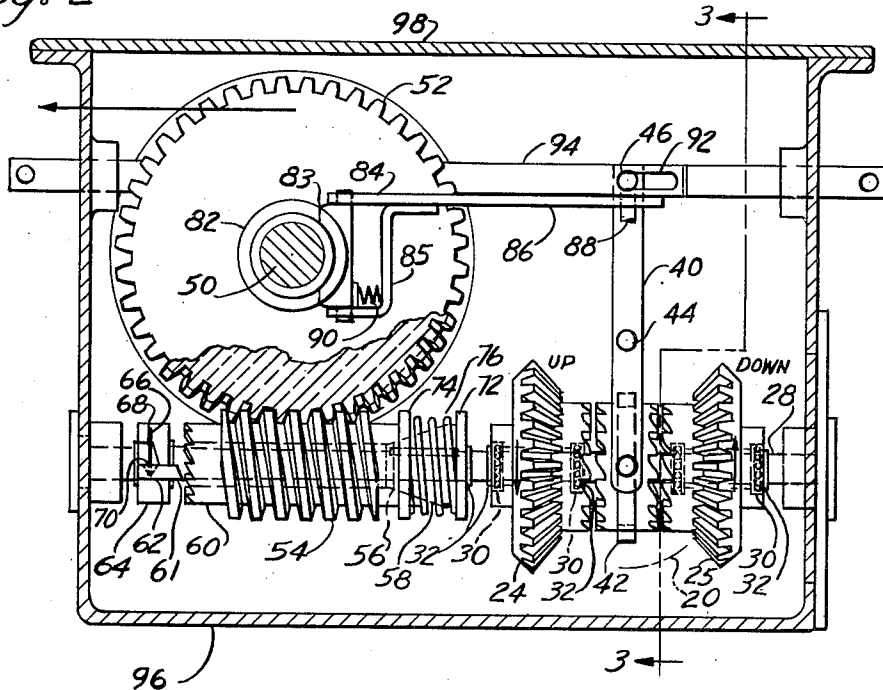
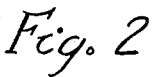


L. D. BARRY

PORTABLE HOIST MECHANISM

3 Sheets-Sheet 1



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2,768,757

PORTABLE HOIST MECHANISM

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3 Sheets-Sheet 2

Fig. 7

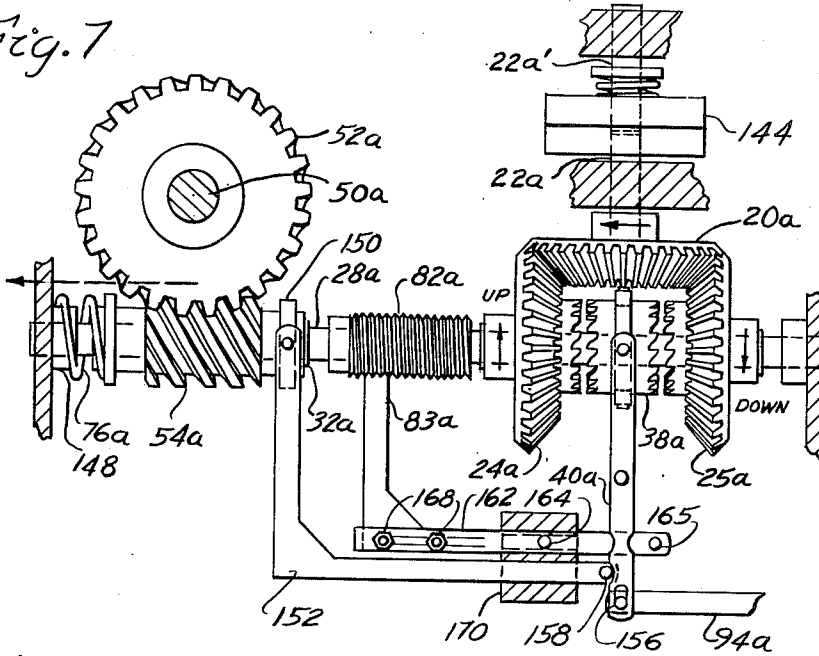


Fig. 8

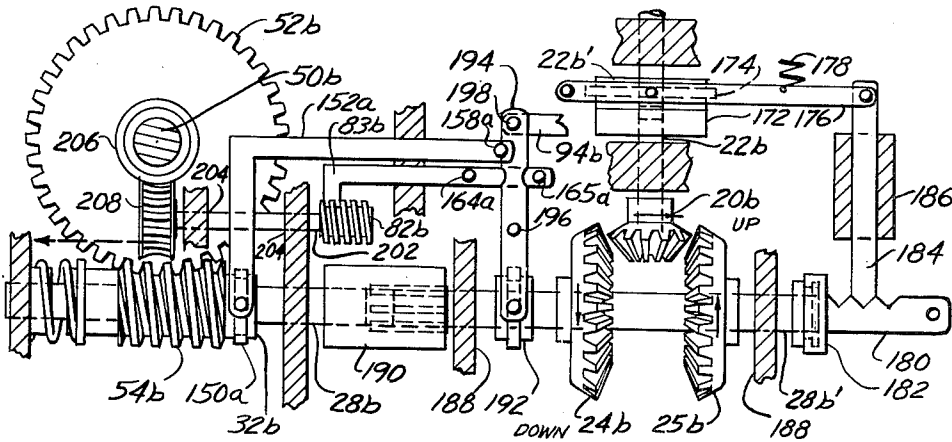
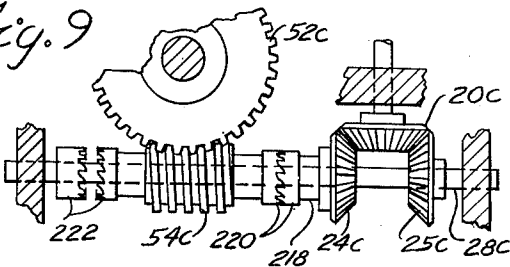


Fig. 9



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PORTABLE HOIST MECHANISM

Leonard D. Barry, Detroit, Mich.

Application July 22, 1952, Serial No. 300,229

18 Claims. (Cl. 214—75)

This invention relates to a hoisting mechanism and in particular to a drive unit for operating a cable hoist from a power take-off shaft or a shaft having rotation in one direction only.

This invention is a continuation in part of my pending patent application Serial No. 95,477, on Portable Hoist, filed May 26, 1949, and now Patent No. 2,640,612.

An object of this invention is to provide a hoist mechanism suitable for application to trucks whereon it can be conveniently operated at the hoist; held against slipping when lifting, lowering, and when stopped; and operated from a power take-off shaft.

Using the well-known principle of the worm gear reducer as a means to hold the hoist from slipping, an object of this invention is to provide a simple reversible drive therefor to operate from a unidirectional source of power and to enable slippage on the input side of the worm gear reducer to start the hoist in motion smoothly and yet hold the load positively.

A further object is to include necessary and precautionary safety features provided by mechanical means to enable application of this hoist where electrical power is not available or convenient to apply. For safety in particular, it is an object to prevent the reeling out of the cables when slack, since this indicates that the hoist has stuck and might drop if the cables were reeled out. It is also an object to automatically stop the hoist at upper and lower limits of travel and thereat permit only reverse operation, thereby preventing damage at the upper limit of travel and preventing the reversing of the direction of the cable wrap at the lower limit of travel. A further object of safety is directed to the handiness of the control lever linkage which runs vertically up the truck so that it is within reach of the operator even when he rides on the hoist and a linked portion of the control to stop the raising of the hoist if anything gets caught between the underside of the truck body and the top of the hoist platform.

A further object is to prevent the formation of a second layer of the cable on the drum, since the load on the second layer would squeeze the cable into the first layer and drop one side of the hoist a fraction of an inch with respect to the other side and, since with a truck cable hoist about five turns are sufficient on a six inch diameter drum.

Another object is to provide a simple and dependable mechanical means to utilize the slackness of the hoisting cables for control.

Other objects are to provide a hoist mechanism convenient and simple to operate, dependable, protected against overload, smooth in operation, and having a construction which is relatively simple, inexpensive, and low in maintenance requirements.

These and other objects are attained by my mechanism disclosed herein, forms of which are shown in the accompanying drawings, the various views of which are briefly described as:

Figure 1, a top view of the preferred form of the hoisting mechanism with cover removed and parts broken away to show the details.

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Figure 2, a sectional view taken on line 2—2 of Figure 1 with parts broken away.

Figure 3, a sectional view taken on line 3—3 of Figure 2 with a guide and coupling added to the hoisting mechanism to provide axial movement of the cable drums.

Figure 4, a plan view showing the application of the hoisting mechanism on a truck.

Figure 5, a side elevation of a truck showing the control as applied thereto.

Figure 6, a view taken on line 6—6 of Figure 5.

Figure 7, a schematic view of an alternative variation of the hoist mechanism.

Figure 8, a schematic view of still another variation of the hoist mechanism.

Figure 9, a schematic view of a hoist mechanism adapted to operate a skip car.

Referring to the drawings and in particular to Figures 1 through 3, beveled gear 20, fixed on shaft 22 by shear pin 23, meshes beveled gears 24 and 25, both mounted free to turn on shaft 28 with ball bearing 30 and retained laterally on the shaft by retaining rings 32. The facing faces 34 and 35 of beveled gears 24 and 25 respectively each have a spiral jaw clutch surface. A clutch member 38, slidably keyed on shaft 28 between gears 24 and 25, has a spiral clutch surface on both sides thereof which can selectively engage either face 34 or 35 according to whether the hoist is to be raised or lowered. Shifter yoke lever 40, loosely pivoted on a slip collar 42 on clutch member 38 and pivoted at its fulcrum 44, is actuated by linkage about pin 46. Output or cable shaft 50 has worm gear 52 fixed thereto. Worm 54, mounted free to rotate on shaft 28 and have limited lateral movement, engages worm gear 52. The load on the output shaft, being indicated by an arrow, represents the weight of the hoist pulling the cables taut. This load when being added moves the worm axially as the worm gear rotates a fraction of a turn. At the forward end of the worm, as determined by the movement of loading, a female conical clutch surface 56 is provided. A male clutch member 58, secured to shaft 28, is engaged therewith under this load; the greater the load the greater the torque which can be transmitted by the clutch. The clutch faces are designed to slip to prevent jerking of the hoist when starting and slip substantially independent of the additional load to be hoisted. Whenever the hoist cables become slack a ratchet wheel surface 60 on the other end of worm 54 engages therewith a ratchet 61 held in a groove 62 on a ratchet collar 64 fixed on shaft 28 at a distance from the end of the worm to enable the worm to slide theretoward to disengage the clutch. A leaf spring 66, held in slot 68 on the ratchet collar 64 and the other end engaged in a recess 70 in the ratchet, holds the ratchet against the ratchet wheel when cables are slack. A flange 72 on the male clutch 58 and a flange 74 on the worm support therebetween spring 76 which disengages the conical clutch when the load is removed, that is when the cables become slack. Ratchet 61 and ratchet wheel 60 engage in the slack cable position of the worm whereby the worm can be turned in the direction to lift the hoist but cannot reel out any rope.

A worm or screw member 82, secured on shaft 50, has a follower 83 engaged in the groove thereof. Member 82 has a larger diameter than shaft 50 so that if by misadjustment follower 83 reaches either end of the groove it is free to ride out. Follower 83 is loosely secured radially with respect to the groove of member 82 between arms 84 and 85 of ball crank 86, pivoted at 88, so that follower 83 can follow the groove along member 82 without requiring member 82 to be dish to the arc of a follower rigid on the bell crank lever. Follower 83 is held in the groove of member 82 by spring 90. The end of the bell crank opposite the follower is provided

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with an upright portion having slot 92 engaging pin 46 on yoke lever 40 to form a yoke lever actuator. Bell crank 86 moves lever 40, disengaging double-faced clutch member 38 from either face 34 or 35 at the limits of travel for the hoist. A manual control rod 94 has a hole therein also engaging pin 46 whereby the operator can shift from the neutral position, shown in Figures 1-3, to either face 34 or 35 to respectively raise or lower the hoist subject to the position of the follower and the upright portion of the bell crank, which is shown in the bottom limit of travel thereat preventing further lowering of the hoist, limiting the operator to raise the hoist. Likewise when the follower reaches the other end of threaded member 82 the opposite end of slot 92 reaches pin 46 and moves thereby the yoke lever from face 34 to neutral, stopping the hoist and limiting the operator to lower the hoist.

The mechanism is enclosed by housing 96, which is supplied with bearings for the various shafts, a cover 98, and covered openings for convenient assembly. The whole mechanism is protected by shear pin 23 if the hoist or mechanism gets caught or struck. The gears of the mechanism are lubricated by an oil bath deep enough to cover the bottom of worm 54.

Input shaft 22 is connected to rotate counterclockwise as viewed from the input end. Drive gear 20 drives gear 24 clockwise and gear 25 counterclockwise as viewed from the worm end of the shaft. Upon shifting lever 40 to engage the twin clutch member 38 with the clutch face on gear 24 the hoist is lifted through the worm reduction gearing. If the cables become slack for any reason worm 54 is pushed by spring 76 to disengage the conical clutch, but operation is continued by the ratchet engaging, and the operator is prevented from lowering the hoist. When the load is again restored spring 76 is compressed and clutch face 35 can be engaged for lowering, during which time the cables must be tight to hold worm 54 against clutch 58. If the cables become slack while lowering clutch 58 is opened and ratchet 61 turns past the ratchet wheel teeth; the worm, being free to turn on shaft 28, remains stationary as shaft 28 revolves; and the cables are not reeled out. The operator can then take neutral position stopping rotation of shaft 28, raise the hoist cables, or as soon as the load is again added clutch 58 is engaged, after which the hoist can be lowered.

As a means for wrapping the hoisting cables evenly along the cable drums, cable drum shaft 100 is slidably coupled to output shaft 50 by coupling 102. A threaded cylinder 104 is fixed on shaft 100 near the coupling, and block 106 engages with the groove of cylinder 104 and is fixed to bracket 108 secured to the side of the housing 96 by bolts 110. Coupling 102 is secured to shaft 50 by pin 112, and the end thereof in which slides shaft 100 is tapered to prevent catching things between the coupling and the cylinder as the cable drum shaft threads in. This portion of the mechanism could be enclosed separately or as part of the housing for the rest of the mechanism. It can be omitted where grooved drums or other means for distributing the cable are used or in hoisting applications not requiring special distributing means and therefore is shown detachable.

Referring to Figure 4, the hoisting unit described is shown applied to hoist H on the side of truck T. The cable drum shaft 100 is continued to cable drums 114 by a separate length of shafting 100' coupled to length 100 by flexible coupling 118. Length 100' is supported in bearings 120. The power take-off shaft 122 is coupled to input shaft 22 through flexible coupling 124. The control rod 94 extends at both ends of housing 96. Hoist control linkage is connected to rod 94 at the hoist side of truck T.

Referring to Figures 5 and 6, one possible arrangement of the control linkage is shown as applied to the side of a closed body truck T. The relative size of the linkage is exaggerated to make clear the details. Bell crank 130 transfers the linear motion required by rod 94 to lever

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132 in a plane parallel to the side of the truck. Linkage 134 pivotally attached vertically thereto provides handy control for the operator. Linkage 136, run under the truck body along the door opening D, provides a safety stop for the hoist. A skirt 138, on the truck body, together with a wide portion 139, of linkage 136, forms an enclosure to prevent anything on the hoist platform P slipping between the truck body and the linkage 136. If anything slips between the platform P and the linkage 136 the hoist upon being raised will automatically be shut off by means of linkage 136. The linkages 134 and 136 are mounted to have parallelogram movement on arms 140 and could be mounted for operation in a different plane such as perpendicular to the truck instead of parallel.

Having thus described the preferred form of the hoist mechanism, schematic views are used to more simply illustrate the principles of details as well as indicate the many possible variations which come within the scope of this invention. Various parts in schematic views can be revolved to different relative planes. Parts which serve a similar function in the different forms of the hoist shown in the figures are given the same number suffixed by a letter.

Referring to Figure 7, input shaft 22a is coupled to aligned power input shaft 22a' through spring loaded clutch 144. Beveled gear 20a, secured to shaft 22a, engages beveled gears 24a and 25a mounted to oppositely revolve on shaft 28a with a centrally located double faced clutch unit 38a keyed thereto whereby the motion of either or neither beveled gear 24a or 25a is given to shaft 28a as previously described. Likewise the output shaft 50a is provided with worm gear 52a engaging worm 54a slidably mounted on shaft 28a but keyed to revolve therewith. Worm 54a is spring loaded by spring 76a acting oppositely to the load, not present, which if present would be applied as shown by the dashed arrow. Stops are provided by retaining ring 32a and the bearing 148 which limit the axial movement of worm 54a. A slip collar 150 on worm 54a moves linkage 152 to disengage from and prevent engagement of the twin clutch 38a with the beveled gear 25a, which has a direction of motion for lowering the hoist. Twin clutch 38a is shifted by yoke lever 40a. Different controls for shifting lever 40a are applied at different points, making illustration clear. Hand control 94a has a pin 156 which engages an elongated hole in lever 40a. Linkage 152 has a pin 158 which pushes lever 40a upon the cables becoming slack while lowering. A mechanical turn-limit is provided by threaded cylinder 82a, secured to shaft 28a, and a thread following rider 83a assembled in a linkage 162 having pins 164 and 165 for moving lever 40a to disengage power at the lower and upper limits of travel respectively. Pins 164 and 165 are each secured to a separate strip. The strips are held together and to rider 83a by bolts 168, each through a hole in rider 83a and through elongated holes in the strips, to form linkage 162 in which the relative positions of the pins and the lever 40a in a given position can be adjusted so as to automatically stop the hoist at desired limits of travel; for example, level with the truck bed. Block 170 guides linkages 152 and 162.

This hoist mechanism differs from that shown in Figures 1-3 in that instead of a clutch being directly disengaged when the cable goes slack the twin clutch is disengaged through linkage 152 and, since the intermediate shaft 28a then stops, the worm is keyed to turn with the shaft. The ratchet assembly and cone clutch are therefore omitted.

The number of turns within the limits of travel and the turns on the turn-limit cylinder determine the gearing used therewith; if only a few turns are required the cylinder can be mounted on the intermediate shaft and have a small pitch and many turns; otherwise it is placed on a slower moving shaft, as the output shaft Figures

1-3, or on a separate shaft geared down, as shown in Figure 8.

Referring to Figure 8, this hoist mechanism differs from the previous mechanisms in that the intermediate shaft is in two sections 28b and 28b'. Beveled gears 24b and 25b are fixed on shaft 28b' and are selectively engaged with beveled gear 20b on input shaft 22b connected to aligned input shaft 22b' by clutch 172. Clutch 172 has a slip collar 174 and yoke lever 176 thereon. Spring 178 bearing on lever 176 forces the face of clutch 172 mounted on the input shaft 22b' against the face mounted on input shaft 22b. Beveled gear 20b is shown out of engagement with beveled gears 24b and 25b either of which can be selectively engaged therewith by movement of shaft 28b' preferably by means of yoke bar 180 and yoke collar 182. Yoke bar 180 has three V-shaped notches in which extend rod 184 guided by sleeve 186 and pivoted to lever 176 so as to open clutch 172 as shaft 28b' is shifted to engage and disengage beveled gears. This saves the gear teeth and is an improvement over my previous showing in my patent application cited. Intermediate shaft 28b' is slidably supported in bearings 188 and coupled to intermediate shaft 28b by slip coupling 190 fixed on shaft 28b.

Similarly as in Figure 7 worm gear 52b, on output shaft 50b, is engaged with worm 54b slidably keyed to shaft 28b. A shifting collar 192 is secured to shaft 28b' and provided with yoke lever 194 pivoted at 196 to which control rod 94b is pivoted at 198. About one end of worm 54b is mounted slip collar 150a supporting linkage 152a having pin 158a which engages lever 194 to shift shaft 28b' and disengage beveled gear 24b from 20b when the cables go slack. Turn limit groove cylinder 82b is secured to shaft 202, bearing in 204, and driven through worm 206, secured to shaft 50b, and engaging worm gear 208 fixed on shaft 202. Rider (also called follower) 83b is engaged with the groove on cylinder 82b and is connected by linkage to actuate lever 194 through pins 164a and 165a respectively at the lower and upper limits of travel.

The operation of all three hoisting mechanisms is similar with respect to the operator, and Figures 4-6 apply for all.

Having thus described three forms of hoisting mechanism embodying my invention for the same general application, different applications or requirements may require a slightly different function and arrangement of parts. For example, low cable tension may be a condition reached at which the direction of rotation of the cable drums is reversed instead of stopped.

The skip car hoist mechanism, Figure 9, illustrates an application of this modified operation. One of two facing beveled gears 25c is fastened on intermediate shaft 28c, the other 24c on sleeve 218 about shaft 28c whereby each beveled gear, driven by beveled gear 20c, drives clutches 220 and 222 respectively at opposite ends of worm 54c whereby the worm, free to slip on shaft 28c and have axial movement between the clutch faces, is driven by one clutch when the cable has more than a certain load and driven in the opposite direction by the other clutch when the load is emptied.

Other variations could include the substitution of friction gears for toothed gears, additional units of speed reduction, gravity and weight to take the place of the spring which moves the worm when the cables go slack.

Axial movement of the worm under variations of torque loading in a worm gear combination can be utilized for general control purposes; it can indicate overload, underload, or the torque required of the drive for increasing the power thereto.

It is understood that various changes, modifications, and applications may be made in the embodiment of my invention within the scope of the appended claims without departing from the spirit and scope of this invention.

I claim:

1. A hoist mechanism which comprises; an input shaft; a beveled gear thereon; a second shaft; two driven beveled gears free to rotate on said second shaft each in mesh with said first mentioned beveled gear; a twin clutch, a central portion thereof secured to rotate with said second shaft, end clutch faces on each facing face of said driven beveled gears; shifting means for said central portion whereby either or neither clutch face can be selectively engaged; an output shaft; a worm gear thereon; a worm engaged therewith free to rotate on said second shaft; a second clutch, one face member thereof secured on said second shaft, the other face member on said worm; a ratchet wheel and ratchet associated with said worm so to connect said worm to rotate with said second shaft to raise but not to lower the hoist; said worm having axial movement whereby said second clutch is engaged by a load on said output shaft and said ratchet and ratchet wheel are engaged when the load is removed.

2. A hoist mechanism which comprises, an input shaft, a beveled gear thereon, a second shaft, two beveled gears free to rotate on said second shaft and each in mesh with said first mentioned beveled gear, a clutch associated with each said second mentioned beveled gears whereby said gears may be selectively engaged with said second shaft, shifter yoke means whereby said clutches are operated only one engaging at a time, an output shaft, a worm gear thereon, a worm engaged therewith free to rotate on said second shaft and have axial movement, a second clutch, one face member thereof secured on said second shaft, the other face member composite with said worm, ratchet means associated with said worm so to connect said worm to rotate with said second shaft as to raise but not to lower a hoist, spring means for normally engaging said worm with said ratchet means, said worm having axial movement whereby said second clutch is engaged by a load on said output shaft which transmitted to said worm gear and worm opposes and exceeds the force of said spring means.

3. A hoist mechanism as claimed in claim 2, said second clutch being conical, a flange on each mating part thereof, said spring being located between said flanges for normally maintaining said second clutch disengaged.

4. A hoist mechanism which comprises, an input shaft, a driving beveled gear thereon, a second shaft, two driven beveled gears free to rotate on said second shaft each in mesh with said first mentioned beveled gear, a double clutch associated with both said driven beveled gears whereby said gears may be selectively engaged to drive said second shaft one at a time, shifter yoke means for operating said clutch, an output shaft, a worm gear secured thereon, a worm on said second shaft engaging said worm gear, a screw member associated for revolving on its axis with relation to said output shaft, a screw following rider continuously engaged with said screw member, mechanical connection between said rider and said shifter yoke means whereby said yoke is moved after a predetermined number of revolutions of said screw member in a given direction.

5. A hoist mechanism as claimed in claim 4, said mechanical connection between said rider and said shifter yoke means being a lever, forked arms thereon supporting said rider loosely radially with respect to said screw member, spring means for holding said rider against said screw member whereby said rider has movement with respect to said arms as the arms trace an arc and the rider follows the surface of said screw member.

6. A hoist mechanism which comprises; an input shaft; a driving beveled gear thereon; a second shaft; two driven beveled gears free to revolve thereon, each in mesh with said driving beveled gear; a twin clutch, end clutch faces thereof on each facing face of said driven beveled gear, a double faced portion of said twin clutch secured to rotate with said second shaft between said end clutch faces and have axial movement to engage selectively

either or neither said end clutch face; a slip collar on said double faced portion; a yoke lever pivoted thereto; an output shaft; a worm gear thereon; a worm on said second shaft engaging said worm gear; a second clutch, one face member thereof secured on said second shaft, the other face member on said worm; ratchet means associated with said worm so to connect said worm to rotate with said second shaft to raise but not to lower the hoist; said worm having axial movement whereby said second clutch is engaged by a load on said output shaft and said ratchet means is engaged when the load is off; a screw which revolves on its axis at a velocity proportional to that of the output shaft; a rider engaged to follow said screw; mechanical connection between said yoke lever and said rider whereby said yoke lever is moved after a predetermined number of revolutions of said screw in a given direction; control linkage for operating said yoke lever.

7. A hoist mechanism as claimed in claim 6, said control linkage comprising for application on a truck body; a bar mounted horizontally under the body of a truck parallel and close to a truck hoist platform to be operated thereby, arms pivotally suspending said bar to provide parallelogram movement, said bar being linked to said shifting means and arranged so as to stop the hoist if anything gets caught between the platform and the bar as the hoist rises.

8. A hoist mechanism which comprises, an input shaft, a driving beveled gear thereon, an intermediate shaft, two driven beveled gears free to revolve thereon each in mesh with said driving beveled gear, a twin clutch, end clutch faces thereof on each facing face of said driven beveled gears, a double faced portion of said twin clutch secured to rotate with said intermediate shaft between said end clutch faces and have axial movement to engage selectively either or neither said end clutch face, a slip collar on said double faced portion, a yoke lever pivoted thereto, an output shaft, a worm gear thereon, a worm engaging said worm gear slidably mounted on said intermediate shaft so as to turn therewith, means for limiting the axial movement of said worm, spring means for normally holding said worm against one limit of its axial motion, load means to be applied to the output shaft to move said worm to the opposite limit, a slip collar on said worm, linkage between said slip collar and said yoke lever to disengage the twin clutch faces which transmit rotation to said worm gear in the direction yielding the load when the load is removed, manual means for actuating said twin clutch subject to the position of said linkage.

9. A hoist mechanism which comprises, input shafting, driven shafting, a beveled gear on said input shafting, two beveled gears on said intermediate shafting arranged so as to be oppositely driven by said first mentioned beveled gear, shifting means for driving selectively said driven shafting from either said second mentioned beveled gears, a screw member associated for rotation with said driven shafting, a rider engaging said screw member thereon, said rider being moved along said screw member by the turning thereof, mechanical means for transmitting and guiding the movement of said rider to said shifting means to disengage said driven shafting from power transmitted through either said second mentioned beveled gears after a predetermined number of rotations of the driven shafting in a given direction.

10. A hoist mechanism which comprises, two aligned lengths of input shafting, a clutch therebetween, a slip collar on said clutch, a yoke lever pivotally attached to said collar, a beveled gear secured on one said length of input shafting, a first and second length of intermediate shafting, means for transmitting rotation between said length of intermediate shafting permitting relative axial movement of said first length, two beveled gears secured on said first length arranged so as to be oppositely driven by engagement with said first mentioned bevel gear, shifting means for moving said first length to selectively en-

gage either or neither second mentioned beveled gear with said first mentioned beveled gear, an output shaft, a worm gear thereon, a worm engaged therewith and engaged to rotate with and have axial movement on said second length, stops to limit axial movement of said worm, spring means opposing the load to be applied and normally holding said worm against a said stop, linkage connecting said worm to said shifting means whereby said beveled gear for driving a load down is prevented from engagement with said first mentioned gear except when there is sufficient load to axially move said worm a sufficient distance opposing the force of said spring means.

11. In a mechanism, two aligned lengths of input shafting, a clutch therebetween, a slip collar on said clutch, a yoke lever pivotally attached to said collar, a beveled gear secured on one said length of input shafting, intermediate shafting, two beveled gears on said intermediate shafting arranged so as to be oppositely driven by engagement with said first mentioned beveled gear, shifting means for selectively engaging either or neither second mentioned beveled gear with said first mentioned beveled gear, spring means for normally holding said clutch engaged, a notched member associated with said shifting means so as to move therewith, engaging means extending from said yoke lever and engaging said notched member so as to ride thereon and receive in-and-out motion from the movement of and with respect to said notched member, said spring means holding said engaging means against said notched member, said notched member together with said engaging means being arranged to both disengage said clutch while said beveled gears are shifted and hold the engagement of said beveled gears.

12. A worm axially slidably mounted, a worm gear engaged with said worm and rotatable on the axis of said worm gear by the axial sliding of said worm, two power-transmission means each engaged at an end of axial travel of said worm by the axial movement of said worm to the said power-transmission means, drive means arranged to oppositely drive each said power-transmission means whereby said worm is oppositely driven according to which said power-transmission means is engaged, the torque load on said worm gear determining the axial position of said worm and so the direction of rotation of said worm gear.

13. A shaft, a worm slidably and rotatably mounted thereon, a worm gear engaged with said worm, a clutch mounted at one end of said worm one face thereof on the worm and the other face member secured to said shaft, means limiting axial motion of said worm from the shaft mounted clutch face and means for holding said clutch normally disengaged whereby said worm has substantial but limited axial movement to engage and disengage said clutch according to the resistance to axial movement of the worm, whereby said clutch is engaged or disengaged depending on the load transmitted from the worm gear to the worm.

14. A worm mounted to revolve on its axis and have substantial axial movement, a worm gear engaged with said worm, stops to limit axial movement of said worm, spring means pressing said worm axially against a said stop, the load to be applied to move the worm to the opposite said stop, clutch means arranged to transmit rotation to said worm and engaged by a sufficient load so applied to said worm gear that the torque transmitted to the worm opposes said spring means, said clutch disengaging upon removal of said load by the force of said spring.

15. A hoist mechanism which comprises an input shaft, intermediate shafting, an output shaft gearing whereby said intermediate shafting can be driven in either direction when said input shaft is rotated in one direction, a worm gear on said output shaft, a worm axially moveable on said intermediate shafting and engaging said worm gear, engaging means arranged to selectively drive said worm when said input shaft is driven, and means insuring that a certain engagement of said engaging means

is disconnected whenever the torque load on said worm is less than a minimum value.

16. In a hoist mechanism, a worm keyed to turn with a shaft and axially slidable thereon, a worm gear engaged with said worm, reverse gearing arranged whereby said worm can be driven in opposite directions according to the engagement of said gearing, shifting means for disengaging and reversely engaging said gearing, control linkage secured so as to be axially moved with said worm and connected and arranged in such a way that a particular engagement of said gearing is held disengaged whenever the torque load on said worm gear is reduced below a certain low amount.

17. In a mechanism, a worm gear, a worm in mesh therewith, means for driving said worm in either direction, said worm having substantial axial movement under variation of torque from zero to normal load on the worm gear, means for limiting the direction of rotation of said worm according to the direction and value of the torque load on the worm gear, engaging means arranged to be controlled by axial movement of said worm so as to engage and disengage said means for limiting according to the axial position of said worm, whereby said worm can be driven in only a predetermined direction when said means for limiting is engaged by said engaging means.

18. In combination, a worm slidably and rotatably mounted on its axis, a worm gear operably engaged with said worm, clutch means on the end faces of said worm,

a clutch mounted concentric with the axis of said worm at each end of said worm arranged to engage said clutch means on said worm by the axial movement of the worm thereto, means to differently drive each said clutch at the same time, whereby said worm gear is driven differently according to its torque load.

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