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(54) WINCH DISCONNECT CONTROL ARRANGEMENT

(71) We, CATERPILLAR TRACTOR CO., a corporation organized and existing under the laws of the State of California, United States of America, of 100 N. E. Adams Street, Peoria, Illinois 61629, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a control system for a cable drum of a winch assembly such as a towing winch of the type used in the construction, logging, pipeline-laying, mining and reclamation industries.

A conventional winch is normally actuated by a power take-off from the engine of a construction vehicle on which the winch is mounted. A typical winch of this type is disclosed in Patent Specification No. 1,349,924 wherein a pair of winch clutches are operatively connectible to a cable drum to place the winch in the following modes of operation: "Reel-out" wherein only one of the winch clutches is engaged to pay-out the cable by rotating the drum in a first direction; "Reel-in" wherein only the other one of the winch clutches is engaged to rotate the cable drum in a second opposite direction; or "Brake-on" wherein both of the winch clutches are engaged to prevent rotation of the cable drum. It has been found desirable to further employ a disconnect clutch of the type disclosed in Patent Specification No. 1420303, for example, in the drive train between the winch clutches and the cable drum to permit the cable drum to "freewheel" upon disconnection of the disconnect clutch.

It has been found further desirable to provide control means for actuation of such disconnect clutch. When the disconnect clutch is in its disengaged condition of operation inadvertent movement of the control handle for the winch clutches to place them in their reel-in or reel-out mode of operation could expose the disconnect clutch to damage upon re-engagement thereof. This possibility is particularly apparent with respect to a disconnect clutch of the axially engaging positive-type.

In accordance with the invention, a control system for a cable drum of a winch assembly comprises drive means, an output member which is arranged to be driven by the drive means and to be coupled in use to the cable drum, first control means for selectively actuating the drive means to rotate the output member, disconnect means for selectively disconnecting the drive means from the output member, second control means for selectively actuating the disconnect means, and retaining means for preventing actuation of the first control means when the second control means is so actuated that the drive means is disconnected from the output member by the disconnect means and for permitting actuation of the first control means when the second control means is so actuated that the drive means is not disconnected from the output member by the disconnect means.

This new control system facilitates expeditious and precise control by an operator.

The first and second control means may each comprise a handle movably mounted on an operator's station of a construction vehicle fitted with a winch assembly with the retaining means being operatively connected to the handle of the second control means for movement therewith. The two control handles may be mounted in close proximity to each other on an operator's station of a vehicle.

One example of a track-laying tractor having a winch assembly fitted with a control system in accordance with the invention is illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation;

Figure 2 is a sectional view through a portion of a drive train employed to selectively rotate a cable drum of the winch assembly;

Figure 3 is an enlarged and partially sectioned top plan view of the winch assembly;

Figure 4 is an enlarged sectional view of a disconnect clutch employed in the winch

assembly and exposed in Figure 3 by a section line;

Figure 5 illustrates a portion of a control system for selectively actuating the winch assembly;

Figure 6 is a partially sectional side elevational view of handles and attendant linkages employed in such control system;

Figure 7 is a top plan view, taken in the direction of arrows VII—VII in Figure 6, of a guide plate for one of the handles employed for selectively actuating the input and winch clutches of the control system;

Figure 8 is a top plan sectional view, taken in the direction of arrows VIII—VIII in Figure 6; and

Figure 9 is a view similar to Figure 8, but showing the relative positions of a handle for the disconnect clutch and a retaining plate employed therewith upon disengagement of such clutch.

Referring to Figure 1, a construction vehicle or track-laying tractor 10 has a winch assembly 11 mounted on a rearward end thereof. The winch assembly comprises a cable drum 12 adapted to be rotated by a drive means, including a power input means or shaft 13 (Figure 2) constituting a standard power take-off from an internal combustion engine (not shown). A normally disengaged input clutch means 14 may be actuated to couple the input shaft 13 with winch input means comprising a gear 15 which meshes with a gear 16 splined to a rotatable shaft 17.

The shaft 17 has a bevel gear 18 secured on an end thereof to mesh with a pair of bevel gears 19 and 20, rotatably mounted on a countershaft 21 of the winch assembly (Figure 3). The shaft has a pinion gear 22 rotatably mounted on the end thereof and meshing with a spur gear 23 which forms an output member, secured to a shaft 24 rotatably mounted on the winch assembly. A second gear 25 is secured to the shaft 24 to mesh with a gear 26 secured to a shaft 27, rotatably mounted in the winch assembly and carrying the cable drum thereon.

The above, briefly described drive means for the cable drum is more fully described in Patent Specification No. 1349924. Such patent further describes a first control means for selectively actuating such drive means and, in particular, for selectively actuating the input clutch 14 (Figure 2) and a pair of winch clutches 29 and 30 (Figure 3).

In general, the control means functions to condition the winch assembly and control system therefor for the following modes of operation in response to actuation of a first control handle 31 (Figure 7): "Neutral" (N) wherein the lever is positioned, as illustrated, to engage the winch clutches 29 and 30 and to disengage the input clutch 14; "Reel-out" (O) wherein the handle is moved rightwardly in one slot to disengage the winch clutch 29 only and to engage the input clutch to rotate the cable drum in a first direction to pay-out cable therefrom; "Reel-in" (I) wherein the handle is moved rightwardly in the other slot to disengage the winch clutch 30 only and to engage the input clutch to rotate the cable drum in a second, opposite direction to reel-in the cable; and "Free-spool" (F) wherein all of the clutches are disengaged to permit the drum to rotate freely.

Referring to Figures 3 and 4, a disconnect means 32 is operatively connected in the drive means for the cable drum, between the countershaft 21 and gear 23, for selectively disconnecting the drive means from the cable drum. Such disconnect means, fully described in Patent Specification No. 1420303, essentially comprises a positive, axially engaging clutch 33 including a plurality of circumferentially disposed dog teeth 34 formed on the outboard side of the gear 22 and a plurality of matched dog teeth 35 formed on the inboard side of an annular connecting member 36. The member 36 is connected to a piston 37 for simultaneous axial movement therewith by a cross-pin 38.

The clutch 33, shown in its disengaged condition of operation, is normally biased to its engaged condition to intermesh the teeth 34 and 35 by spring means comprising a plurality of stacked Belleville spring washers 39. In order to disengage the clutch, pressurized hydraulic fluid is communicated from a conduit 40 and into an actuating chamber 41 via passages 42, 43 and 44. In the illustrated disengaged condition of clutch operation, the gear 22 is conditioned to freely rotate on the shaft 21 whereby a workman can readily pull cable from the cable drum 28 and return to an operator's station 45 of the tractor (Figure 1) to commence a towing operation, for example.

As shown in Figures 5 to 6, the control handle 31 extends upwardly through a slotted plate 46 defining the above-described work positions "N", "I", "F" and "O". The plate is formed integrally with a cover 47 attached to a support structure 48 secured to a panel 49 of the vehicle, located at the operator's station thereof. The handle is pivotally mounted on the vehicle to selectively push-pull cables 50 and 51 via standard linkage means 52. The cables are adapted to selectively shift the appropriate spools mounted in a directional control valve 53 to, in turn, selectively actuate the clutches 14, 29 and 30. A typical hydraulic control system for use herein is fully described in above-referenced Patent Specification No. 1349924.

As briefly mentioned above, movement of the handle 31 in Figure 7 to a reel-in (I) or reel-out (O) position would set the shaft 21

in motion along with the gear 22. Although the gear is rotatably mounted on the shaft, surface friction therebetween would cause the gear to rotate with the shaft. Should the operator then engage the clutch 33 by depressurizing the actuating chamber 41 to permit the spring means 39 to move the piston 37 rightwardly to engage the clutch teeth 34 and 35, the teeth could be damaged.

A second control handle 54 is rotatably mounted on a bracket 55 secured to the support structure 48. The handle, adapted to selectively actuate the disconnect clutch 33, is shown in its first or engaged position in Figures 6 and 8 and its second or disengaged position in Figure 9. The second control handle is pivotally connected to a push-pull cable 56 which is further connected to a valve spool 57 reciprocally mounted in the directional control valve 53 to selectively communicate pressurized fluid to the chamber 41 or exhaust such fluid therefrom.

Retaining means, preferably in the form of a flat plate 58, has a bifurcated rearward end which is secured to the handle 54 for simultaneous movement therewith about a common pivot axis. In particular, an inner end 59 of the handle is secured to one side of the plate 58 to pivot the same on the bracket 55. The opposite side of the plate is secured to a block 60 which is, in turn, secured to a pivot pin 61 pivotally mounted on the bracket 55 and aligned with the end 59 of the handle.

A spring means 62, preferably in the form of a retraction coil spring, is interconnected between the bracket 55 and the plate 58 to normally retract the plate to its locked Figure 6 "over-center" position. Upon movement of the handle to its Figure 9 position, the spring means will be displaced to an "under-center" position beneath the pivot axis of the handle 54 to lock the plate 58 in its lowered and disengaged position. As shown in Figures 7 and 9, when the plate is disposed in its lowered position, a notch 63 formed on the forward end thereof will entrap the handle 31 therein to prevent movement thereof to any of its "N", "I" or "O" positions. Thus, the operator must return the handle 54 and the plate 58 to their Figure 6 positions to engage the disconnect clutch 33 prior to actuation of the handle 31 to actuate either one or both of the winch clutches.

It should be further noted that when the handle 31 is disposed in its Figure 7 position and the handle 54 is moved from its Figure 6 to its Figure 9 position that the plate will move the handle 31 automatically to its dotted-line 31^1 position in Figure 7. A spring clip 64 may be secured to the cover 47 to retain the handle 31 in its free-wheel (F) position whereby the winch clutches are disengaged. Also, should the handle 31 be in either its reel-in (I) or reel-out (O) position, a respective leg 65 or 66 of the plate 58 will engage the handle 31 to prevent the operator from disengaging the clutch 33, i.e., rotation of the handle 54 to its Figure 9 position will be prevented.

In operation, an operator will position the tractor adjacent to an object adapted to be connected to the cable of the cable drum 12. He will then actuate the handle 54 to disengage the clutch 33 to entrap the handle 31 within the notch 63 of the plate 58. Thus, the winch and input clutches are disengaged. The operator may then descend from the vehicle and pull the cable from the cable drum by hand which may be easily effected due to the free-wheeling condition of the cable drum and, in particular, disconnection of the gear 22 from the shaft 21. Upon proper positioning of the cable, the operator will then remount the operator's station 45 and return the handle 54 to its Figure 6 position whereby the clutch 33 is re-engaged with the teeth 34 and 35 being in substantial static condition to prevent damage thereto. The operator is then free to perform his various operations with the handle 31 for the control of the input and winch clutches.

WHAT WE CLAIM IS:—

1. A control system for a cable drum of a winch assembly, the system comprising drive means, an output member which is arranged to be driven by the drive means and to be coupled in use to the cable drum, first control means for selectively actuating the drive means to rotate the output member, disconnect means for selectively disconnecting the drive means from the output member, second control means for selectively actuating the disconnect means, and retaining means for preventing actuation of the first control means when the second control means is so actuated that the drive means is disconnected from the output member by the disconnect means and for permitting actuation of the first control means when the second control means is so actuated that the drive means is not disconnected from the output member by the disconnect means.

2. A system according to claim 1, wherein the drive means comprises a power input means, winch input means, a normally disengaged input clutch means which is arranged to be actuated to couple the power input means to the winch input means, and first and second winch clutch means operatively connectible between the output member and the winch input means for selectively rotating the output member; the first control means being arranged simultane-

in motion along with the gear 22. Although the gear is rotatably mounted on the shaft, surface friction therebetween would cause the gear to rotate with the shaft. Should the operator then engage the clutch 33 by depressurizing the actuating chamber 41 to permit the spring means 39 to move the piston 37 rightwardly to engage the clutch teeth 34 and 35, the teeth could be damaged.

A second control handle 54 is rotatably mounted on a bracket 55 secured to the support structure 48. The handle, adapted to selectively actuate the disconnect clutch 33, is shown in its first or engaged position in Figures 6 and 8 and its second or disengaged position in Figure 9. The second control handle is pivotally connected to a push-pull cable 56 which is further connected to a valve spool 57 reciprocally mounted in the directional control valve 53 to selectively communicate pressurized fluid to the chamber 41 or exhaust such fluid therefrom.

Retaining means, preferably in the form of a flat plate 58, has a bifurcated rearward end which is secured to the handle 54 for simultaneous movement therewith about a common pivot axis. In particular, an inner end 59 of the handle is secured to one side of the plate 58 to pivot the same on the bracket 55. The opposite side of the plate is secured to a block 60 which is, in turn, secured to a pivot pin 61 pivotally mounted on the bracket 55 and aligned with the end 59 of the handle.

A spring means 62, preferably in the form of a retraction coil spring, is interconnected between the bracket 55 and the plate 58 to normally retract the plate to its locked Figure 6 "over-center" position. Upon movement of the handle to its Figure 9 position, the spring means will be displaced to an "under-center" position beneath the pivot axis of the handle 54 to lock the plate 58 in its lowered and disengaged position. As shown in Figures 7 and 9, when the plate is disposed in its lowered position, a notch 63 formed on the forward end thereof will entrap the handle 31 therein to prevent movement thereof to any of its "N", "I" or "O" positions. Thus, the operator must return the handle 54 and the plate 58 to their Figure 6 positions to engage the disconnect clutch 33 prior to actuation of the handle 31 to actuate either one or both of the winch clutches.

It should be further noted that when the handle 31 is disposed in its Figure 7 position and the handle 54 is moved from its Figure 6 to its Figure 9 position that the plate will move the handle 31 automatically to its dotted-line 31^1 position in Figure 7. A spring clip 64 may be secured to the cover 47 to retain the handle 31 in its free-wheel (F) position whereby the winch clutches are disengaged. Also, should the handle 31 be in either its reel-in (I) or rel-out (O) position, a respective leg 65 or 66 of the plate 58 will engage the handle 31 to prevent the operator from disengaging the clutch 33, i.e., rotation of the handle 54 to its Figure 9 position will be prevented.

In operation, an operator will position the tractor adjacent to an object adapted to be connected to the cable of the cable drum 12. He will then actuate the handle 54 to disengage the clutch 33 to entrap the handle 31 within the notch 63 of the plate 58. Thus, the winch and input clutches are disengaged. The operator may then descend from the vehicle and pull the cable from the cable drum by hand which may be easily effected due to the free-wheeling condition of the cable drum and, in particular, disconnection of the gear 22 from the shaft 21. Upon proper positioning of the cable, the operator will then remount the operator's station 45 and return the handle 54 to its Figure 6 position whereby the clutch 33 is re-engaged with the teeth 34 and 35 being in substantial static condition to prevent damage thereto. The operator is then free to perform his various operations with the handle 31 for the control of the input and winch clutches.

WHAT WE CLAIM IS:—

1. A control system for a cable drum of a winch assembly, the system comprising drive means, an output member which is arranged to be driven by the drive means and to be coupled in use to the cable drum, first control means for selectively actuating the drive means to rotate the output member, disconnect means for selectively disconnecting the drive means from the output member, second control means for selectively actuating the disconnect means, and retaining means for preventing actuation of the first control means when the second control means is so actuated that the drive means is disconnected from the output member by the disconnect means and for permitting actuation of the first control means when the second control means is so actuated that the drive means is not disconnected from the output member by the disconnect means.

2. A system according to claim 1, wherein the drive means comprises a power input means, winch input means, a normally disengaged input clutch means which is arranged to be actuated to couple the power input means to the winch input means, and first and second winch clutch means operatively connectible between the output member and the winch input means for selectively rotating the output member; the first control means being arranged simultane-

ously to engage the input clutch means and to disengage only the first winch clutch means to rotate the output member in one direction; or simultaneously to engage the input clutch means and to disengage only the second winch clutch means to rotate the output member in the opposite direction; or simultaneously to disengage the first and second winch clutch means.

3. A system according to claim 1 or claim 2, wherein the first control means comprises a single first control handle movably mounted on a support and the second control means comprises a single second control handle mounted on the support adjacent to the first control handle.

4. A system according to claim 3, wherein the first control handle projects through a slotted plate means for guiding control movements thereof and the retaining means comprises a retaining member operatively connected to the second control handle for simultaneous movement therewith and positioned for engagement with the first control handle.

5. A system according to claim 4, wherein the second control handle and the retaining member are each pivotally mounted on the support for actuating movement about a common pivot axis between a first and second positions in which the drive means is not and is, respectively, disconnected from the output member by the disconnect means.

6. A system according to claim 5, further comprising spring means interconnecting the support and the retaining member for holding the retaining member in a locked over-centre or under-centre position relative to the pivot axis in first and second positions thereof, respectively.

7. A system according to claim 5 or claim 6, wherein the retaining member constitutes a flat plate having a notch formed on one end thereof to engage and entrap the first control handle therein upon movement of the second control handle from its first position towards its second position.

8. A system according to any one of claims 3 to 7, further comprising retaining clip means mounted on the support adjacent to the first control handle for selectively holding the handle therein.

9. A system according to any one of the preceding claims, wherein the disconnect means comprises a positive, axially engaging clutch.

10. A winch assembly having a cable drum and a control system according to any one of the preceding claims with the cable drum coupled to the output member of the control system.

11. A winch assembly according to claim 10, substantially as described with reference to the accompanying drawings.

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