A winch for use on a mobile crane to hoist or lower a load comprises a hydraulic winch motor, a shaft driven thereby, a winch drum, and planetary gearing through which the shaft drives the drum. A three-position hydraulic control valve controls motor speed and direction of rotation. The winch further comprises a brake disc connected by a uni-directional clutch to the shaft and spring-applied, hydraulic brake cylinder-released brake pads for frictional engagement with the brake disc. A two-position hydraulic brake valve controls operation of the brake cylinder. Both the control valve and brake valve are part of a control means which further includes a control lever and linkage. The control lever acts through the linkage and is movable from a neutral position (wherein both valves are closed) toward a winch-lower position (wherein the brake valve opens before the control valve) and toward a winch hoist position (wherein the brake valve remains closed but the control valve opens). During lowering, the winch drum starts rotating smoothly as the brake is released and the load begins to descend under the force of gravity before lowering power is applied to the winch motor. During a winch-hoist operation, the uni-directional clutch allows winch drum rotation even though the brake is still applied.

8 Claims, 7 Drawing Figures
WINCH AND CONTROL MEANS THEREFOR

BACKGROUND OF THE INVENTION

Field of Use
This invention relates generally to hydraulic winches, hoists or the like and, particularly, to control means therefor whereby operation of the winch drive motor and winch brake are coordinated.

Description of the Prior Art
Mobile cranes and similar equipment employ a winch rotatable in opposite directions to hoist or lower a load. Some winches are driven by a hydraulic motor and employ a spring-set, hydraulically released brake. Both the motor and the brake are operated by suitable control means. In practice, it is normally necessary to release the brake prior to rotation of the winch motor and, in some equipment, control means are provided to effect automatic operation of the winch motor in a desired direction immediately upon release of the brake so as to prevent a load from falling uncontrolled. In some prior art winches and control means therefor, the hydraulic brake cylinder was directly connected to the hydraulic circuit for the winch motor and a counterbalance valve was provided which caused the winch motor to operate in the lowering direction so as the brake was released. This arrangement has two drawbacks. First, it is possible for a falling load to overtake and use up the available oil supply to the motor and, consequently, to interfere with proper operation of the brake. Second, the aforesaid arrangement does not permit of smooth operation in load handling because power lowering takes place immediately upon release of the brake. It is desirable, therefore, to provide improved winches and control means therefor which overcome these drawbacks and have other advantages.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a winch for a mobile crane or the like which is rotatable in either hoist or lower direction by a hydraulic motor and employs hydraulically releasable brake means. The winch comprises a hydraulic winch motor, a shaft driven thereby, a winch drum, and planetary gears connected between the shaft and the winch drum to drive the latter. The brake means comprise a brake disc connected through a uni-directional clutch to the aforesaid shaft, brake pads for frictional engagement with the brake disc, spring means normally acting to bias the pads against the disc, and a hydraulic brake cylinder pressurizable to release the brake pads. Pressurization of the brake cylinder is controlled by means of a two-way or two-position brake valve. The motor is controlled by means of a three-way control valve. The control valve and brake valve are both operated by means comprising a three-position control lever and a linkage between the control lever and the valves.

With the control lever in neutral, the brake valve is closed and the control valve is in neutral. This results in the brake being set and the motor being stationary. When the control lever is moved from neutral toward lower position, the brake valve opens first to release the brake, the winch begins to rotate under the force of the load, and subsequently the control valve opens to effect lowering operation of the motor and power lowering of the load. This sequence allows for smooth winch operation. When the control lever is moved from neutral toward hoist position, the brake valve remains closed and the brake remains set but the control valve opens to effect hoisting operation of the motor and hoisting of the load. This sequence is possible because the uni-directional clutch between the brake disc and motor shaft allows for relative rotation therebetween in the hoist direction with the brake set.

The aforesaid operations are effected by the control lever acting through a linkage constructed in accordance with the invention and connected to the brake valve and the control valve. The valves are arranged in side-by-side relationship and each valve comprises a linearly movable valve spool, the stem of which extends therefrom. The control stem or spool has a neutral position and is movable outwardly to winch lower position and inwardly to winch hoist position. The brake valve stem or spool has a neutral, closed or brake-applied position and is movable inwardly to brake-release position. The control lever is rigidly connected to a hub or member which is rotatably about a fixed point. The hub or member comprises outwardly extending arms. Latched connection means are connected between the arms and the valve spools. For example, one arm carries a pin which is slideably engageable in a slot in a first link which is pivotably connected to the spool of the control valve. The other arm carries a pin which is pivotably connected to a plate and the plate has a slot which is slideably engageable with a pin on the spool of the brake valve. The plate is provided with a stop pin or projection which is biased into engagement with the said other arm by means of a tension spring connected between the plate and the member. Pivoting of the control lever from neutral toward winch-lower position results in force being transmitted to move the brake valve spool inwardly from closed position to fully open position (to effect release of the brake) prior to force being transmitted to move the control valve spool outwardly from neutral toward winch-lower position. When the brake valve spool bottoms out in fully open position, further movement of the control lever and further outward movement of the control valve spool is possible to increase lowering speed of the winch because the plate pivots on its arm. Pivoting of the control lever from winch-lower position back to neutral results in return of the control valve spool to neutral and subsequent reclosure of the brake valve. Pivoting of the control lever from neutral toward hoist position results in force being transmitted to move the control valve spool inwardly from neutral position toward hoist position but does not result in any movement of the brake valve spool. Pivoting of the control lever from hoist position back to neutral results in return of the control valve spool to neutral but does not result in any movement of the brake valve spool.

DRAWINGS

FIG. 1 is a perspective view of a mobile crane incorporating a winch in accordance with the invention;
FIG. 2 is an enlarged cross-section view of the winch shown in FIG. 1;
FIG. 3 is a schematic view of a hydraulic control circuit for a winch in accordance with the invention;
FIG. 4 is a view showing the brake valve and control valve of FIG. 3 in lowering position;
FIG. 5 is a view showing the brake valve and control valve of FIG. 3 in hoist position;
FIG. 6 is an enlarged side elevational view of the control valve and brake valve shown in FIG. 3; and
FIG. 7 is a detail of the linkage taken on line 7—7 of FIG. 6.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 shows a mobile crane 10 having a winch 12 in accordance with the present invention. Mobile crane 10 comprises an upper crane portion 14 which is mounted for rotation about a vertical axis on the platform 16 of a mobile carrier 18. Upper crane portion 14 comprises a housing 20 to which the lower end of a movable boom 22 is attached for pivotal movement vertically. Winch 12 is mounted on the top rear of housing 20 and is provided with a line 24 for handling a load 26. Line 24 is reeved over a pulley 28 at the end of boom 22. Winch 12 is operable in either the hoist or lower direction and is braked by means of suitable controls (not shown in FIG. 1) which are understood to be located in an operator's cab 30 in housing 20 of crane 10.

Referring to FIG. 2, winch 12 is shown in cross section and comprises a supporting framework 32, on which a conventional hydraulic winch motor 34 is rigidly mounted. Winch motor 34 comprises an output shaft 36, rotatable in either direction, which is connected to a drive shaft 38 which is supported for rotation on supporting framework 32. Winch 12 further comprises a winch drum 44 which is mounted for rotation on supporting framework 32 by means of bearings 46 and 48. Drive shaft 38 is connected through a planetary gear means or mechanism 50 to drum 44 to effect rotation thereof as hereinafter explained. It is to be understood that when hydraulic motor 34 is energized for rotation in either direction it effects corresponding rotation of drive shaft 38 and, through the planetary gear mechanism 50, effects corresponding rotation of winch drum 44.

The planetary gear mechanism 50 connecting the drive or input shaft 38 with the output member or drum 44 comprises the following. A sun gear 51 is fixed on shaft 38 for rotation therewith and is also in constant mesh with a plurality of planetary gears 52 which are circumferentially spaced around a revolvable carrier 53. The planetary gears 52 are also in constant mesh with an internal ring gear 54 which is fixed in the housing of support 32. The carrier 53 also includes an inner member 55 which has internal gears 56 that mesh with a compound gear 57 which rotates freely with respect to shaft 38. The compound gear 57 also includes a gear portion 58 which is in constant mesh with another set of planetary gears 59 that are circumferentially spaced around and rotatably mounted in another carrier 60. The planetary gears 59 are also in constant mesh with a large internal ring gear 61 also rigidly fixed in the housing of support 32. The revolvable carrier 60 has internal splines 62 by means of which it is rotationally fixed to a sleeve 63. The sleeve 63 is mounted on suitable anti-friction bearings 48 and has a key or spline connection 65 with the interior of the drum 44.

Winch 12 further comprises braking means for preventing drum rotation under certain conditions. As FIG. 2 shows, the braking means comprises a brake disc 72 which is mounted on a conventional uni-directional clutch 74 which, in turn, is mounted on drive shaft 38. It is to be understood that when shaft 38 rotates in the hoist direction, there is relative movement between brake disc 72 and drive shaft 38 because of the action of uni-directional clutch 74. However, when drive shaft 38 rotates in the lowering direction, brake disc 72 is rotatable therewith. The brake means further comprise two caliper brake assemblies, each of which comprises two brake pads 78, a hydraulic brake cylinder 80, and brake spring means 82. The brake pads 78 are movably mounted on a bracket 84 which is supported on supporting framework 32 of winch 12. The brake pads 78 are movable by means of a rod 86 from an open or brake-release position wherein they are disengaged from brake disc 72 to a closed or brake-applied position wherein they engage brake disc 72. The brake pads 78 are normally biased to brake-applied position against brake disc 72 by the brake spring means 82 acting through rod 86. However, upon pressurization of brake cylinder 80 from a suitable source of hydraulic fluid, the brake pads 78 are moved against the bias of the brake springs 82 by rod 86 to disengaged position clear of brake disc 72. When the brake pads 78 engage brake disc 72 they prevent rotation of brake disc 72, drive shaft 38 and drum 44 in the winch-lower direction. However, when the brake pads 78 engage brake disc 72 while hydraulic motor 34 and shaft 38 are energized for rotation in the winch-hoist direction, they do not prevent rotation of the motor, drive shaft or drum in the hoist direction because of the operation of uni-directional clutch 74.

FIG. 3 is a schematic diagram of the hydraulic control system for winch motor 34 and brake cylinders 80 of the brake means. It is to be noted that motor 34 and brake cylinder 80 are supplied with hydraulic fluid from separate pumps 110 and 102, respectively, so that fluid loss in one does not affect the other. Only one brake cylinder 80 is shown in FIG. 3.

As FIG. 3 shows, brake cylinder 80 comprises a housing 88 having a piston 90 therein which is spring loaded by a return spring 92. Housing 88 is provided with a fluid port 94 which is connected by a hydraulic fluid line 96 to a winch brake valve 98. Valve 98 is also connected by a fluid line 100 to a conventional hydraulic brake valve pump 102 and by another fluid line 104 to a hydraulic fluid reservoir 107.

Brake valve 98, shown schematically in FIG. 3, is a conventional two-position type hydraulic valve having a movable valve spool 106 which is shown in brake-applied position in FIG. 3 and is movable leftward (with respect to FIG. 3) by means of a valve stem 108 to brake-released position. With brake valve 98 in brake-applied position, fluid line 100 is connected to fluid line 104 and fluid flow from pump 102 is diverted to reservoir 107. Furthermore, in brake-applied position, fluid line 96 is connected to fluid line 104 and any fluid in housing 88 of brake cylinder 80 is exhausted to reservoir 107 as biasing spring 92 biases piston 90 leftward (with respect to FIG. 3) to brake-applied position. This allows the brake pads 78 shown in FIG. 2 to engage brake disc 72. With brake valve 98 in brake-released position, fluid line 100 is connected to fluid line 96 and fluid flow from pump 102 pressurizes brake cylinder 80 to move piston 90 rightward (with respect to FIG. 3) against the bias of spring 92 to brake-release position and causes the brake pads 78 shown in FIG. 2 to disengage from brake disc 72.

Hydraulic motor 34 of winch 12 is supplied with hydraulic operating fluid for rotation in either direction at a desired speed from a conventional hydraulic winch motor pump 110 and fluid flow between pump 110 and motor 34 is controlled by a conventional three-way or
three-position winch control valve 112. Hydraulic winch motor 34 is a conventional hydraulic motor having two fluid ports 114 and 116 and direction of rotation of motor 34 is determined by which of the two ports is pressurized. Speed of rotation of motor 34 is determined by the amount of pressurization. It may be assumed for purposes of discussion that when port 114 of motor 34 is energized, winch 12 rotates in the winch-lower direction and when port 116 is energized, the winch rotates in the winch-hoist direction.

Control valve 112 shown schematically in FIG. 3, is a conventional three-position type hydraulic valve (similar to that shown in U.S. Pat. No. 3,295,551) having a movable valve spool 118 which is shown in neutral position in FIG. 3 and is movable rightward (with respect to FIG. 3) from neutral to winch-lower position and leftward from neutral to winch-hoist position. Movement of valve spool 118 is effected by a valve stem 120. As hereinafter explained, valve stem 108 of brake valve 98 and valve stem 120 of control valve 112 are both operated in coordination by a valve control means comprising a single control lever 122 and a linkage 124. The extent of movement in either direction from neutral of spool 118 of control valve 112 regulates the amount of pressurization of hydraulic motor 34 and thereby controls motor speed.

Control valve 112 is connected by a fluid supply line 126 to pump 110 and by a fluid return line 128 to reservoir 107 through fluid line 104. Control valve 112 is also connected by fluid lines 130 and 132 to the ports 114 and 116, respectively, of winch motor 34. A conventional low pressure relief valve 138 is connected in fluid line 128. A conventional anti-void poppet valve 134 and a main relief unloader valve 136 are connected between fluid supply line 126 and fluid return line 128.

A conventional spring-loaded check valve 140 is connected between fluid line 132 and fluid return line 128. A similar check valve 142 is connected between fluid line 130 and fluid return line 128. When spool 118 of control valve 112 is in neutral position, as shown in FIG. 3, fluid flow from pump 110 to motor 34 is blocked and is diverted through control valve 112, to reservoir 107.

When control valve spool 118 is moved to winch-lower position (i.e., rightward with respect to FIGS. 3 and 4), fluid supply line 126 from pump 110 is connected through control valve 112 to fluid line 130 to effect pressurization of port 114 of winch motor 34. Port 116 of motor 34 is then connected through fluid line 132, valve 112, fluid line 128 and low pressure relief valve 138 to reservoir 107. In this condition, control valve 112 directs rotation of winch motor in the winch-lower direction. As hereinafter noted, the extent of such rightward movement of valve spool 118 determines the speed of rotation of winch motor 34 and winch drum 44.

When control valve spool 118 is moved leftward with respect to FIGS. 3 and 5 from neutral position, the fluid lines 126 and 128 are connected to the fluid lines 132 and 130 by control valve 112, respectively, thereby effecting pressurization of port 116 of winch motor 34. This causes rotation of winch motor 34 and winch drum 44 in the winch-hoist direction and the extent of leftward movement of valve spool 118 controls the speed of rotation.

FIG. 6 is an enlarged side elevational view of control valve 112 and brake valve 98 shown in FIG. 3 and shows their physical configuration and mechanical interconnection. As FIG. 6 shows, brake valve 98 and control valve 112 are rigidly mounted on a suitable supporting structure 146 which is understood to be located in the operator's cab 30 of crane 10. Control valve 112 is physically located above brake valve 98 and both valves are disposed so that their spools 118 and 106, respectively, which extend from the ends of the valve housings are in parallel relationship. The spools 118 and 106 operate or are moved linearly in response to the movement of control lever 122 which acts through linkage 124. Linkage 124 comprises a pivotally movable member 148, in the form of a hub 150, which is mounted for limited rotation on bearing means 152 on a fixed shaft 154 about a point. Shaft 154 is rigidly supported on a housing 156 on supporting structure 146. Control lever 122 is rigidly attached to hub 150 of member 148 and effects rotational movement thereof. In FIG. 6 control lever 122 is shown in neutral position and is understood to be movable counterclockwise or downwardly (with respect to FIG. 6) to winch-lower position and also movable clockwise or upwardly to winch-hoist position. Movable member 148 is provided with upper and lower arms 158 and 160, respectively, which are rigidly secured to hub 150 and extend therefrom. Upper and lower arms 158 and 160 are provided with rigidly attached pins 162 and 164, respectively, at their extreme ends. An upper or first link 166 is connected between pin 162 on upper arm 158 and a pin 170 on valve stem 120 of control valve 112. Link 166 is held in place on the pins 162 and 170 by means of a washer 172 and cotter pins 176 and 178, respectively. Link 166 is provided with a slot 180 which slidably engages pin 162 on arm 158 and serves as a lost-motion connection which allows for limited play or travel between pin 162 and link 166 as control lever 122 is moved from neutral toward winch-lower position.

The pin 164 on lower arm 160 pivotally engages a hole 182 in a second link or toggle plate 184 which is connected to valve stem 108 of brake valve 98. Plate 184 is provided with a slot 186 which slidably engages a pin 188 on the end of shaft 190 which is pivotally connected to valve stem 108 by a pin 192. Pin 188 is secured in slot 186 by means of a washer 194 and cotter pin 196. Plate 184 is connected by biasing means in the form of a tension spring 198 to a projection 200 on hub 150. Spring 198 engages a hole 202 in projection 200 and a pin 204 on plate 184. Plate 184 is provided with stop means such as a stop projection or stop pin 206 which abuts or engages a side of lower arm 160.

FIG. 6 shows control lever 122 in neutral position, control valve 112 in neutral position, and brake valve 98 in brake-applied position. Rotation of control lever 122 downwardly from neutral toward winch-lower position results in force being transmitted by arm 160 to plate 184 to move brake valve stem 108 inwardly (rightward in FIG. 6) from brake-applied position to brake-release position to effect release of the brake. This movement occurs prior to force being transmitted by arm 158 to link 166 to move control valve stem 120 outwardly from neutral toward hoist-lower position. When the brake valve spool 118 bottoms out in full rightward position, further movement of control lever 122 and further outward movement (leftward in FIG. 6) of the control valve spool 118 is possible to increase lowering speed of motor 34 because the plate 184 is able to pivot with respect to arm 160 and shaft 190. Ro-
tation of control lever 122 from hoist-lower position back to neutral results in return of control valve spool 118 to neutral prior to return of brake valve spool 106 to brake-applied position. Rotation of control lever 122 from neutral toward winch-hoist position results in force being transmitted by arm 158 to link 166 to move control valve spool 118 inwardly from neutral position toward winch-hoist position but such movement does not result in any movement of brake valve spool 106 because plate 184 is able to move with respect to pin 186. Rotation of control lever 122 from winch-hoist position back to neutral results in return of control valve spool 118 to neutral but, again, does not result in any movement of brake valve spool 106.

OPERATION

Winch 12 of crane 10 operates as follows. Assume that both pumps 102 and 110 are in operation, that control lever 122 is in neutral, that brake valve 98 is in brake-applied position, and that control valve 112 is in neutral position. With these assumptions, winch motor 34, winch shaft 36 and winch drum 44 are stationary, winch brake cylinder 80 is depressurized and the brake pads 78 engage brake disc 72.

To operate winch 12 in the winch-lower direction, control lever 122 is moved counterclockwise (with respect to FIG. 6) from neutral toward winch-lower position. As this occurs, valve spool 106 of brake valve 98 is moved inwardly from brake-applied to brake-release position, brake cylinder 80 becomes pressurized, and the brake pads 78 disengage from brake disc 72. Winch drum 44 is now free to rotate in the winch-lower direction and begins to do so as load 26 on line 24 of crane 10 begins to descend under the force of gravity. At this point, a smooth transition has occurred as load begins to descend under the force of gravity. As control lever 122 is moved further toward winch-lower position, valve spool 118 of brake valve 98 bottoms out in fully open position, and linkage 124 causes valve spool 118 of control valve to commence movement outwardly with respect to FIG. 6) from neutral toward winch-lower position. Such movement causes port 114 of winch motor 34 to become pressurized and the motor begins rotation in the winch-lower direction. Motor 34 drives shaft 38, and the latter, acting through the planetary gears 50, causes winch drum 44 to be driven in the winch-lower direction. Winch drum 44 is already rotating but now driven for rotation at a faster speed. At this point another smooth transition in drum rotation has occurred. Further, movement of control lever 122 in the winch-lower direction causes an increase in the speed of winch motor 44. Reverse movement of control lever 122 (short of a full return to neutral) results in a decrease in the speed of drum rotation.

When control lever 122 is returned to neutral, linkage 124 causes valve spool 118 of control valve 112 to return to neutral and effect depressurization of port 114 of motor 34. Subsequent to this, linkage 124 effects return movement of valve spool 106 of brake valve 98 to brake-applied position, depressurization of brake cylinder 80, and re-engagement of the brake pads 78 with brake disc 72 to brake winch 12.

To operate winch 12 in the winch-hoist direction, control lever 122 is moved clockwise (with respect to FIG. 6) from neutral toward winch-hoist position. As this occurs, valve spool 118 of control valve 112 is moved inwardly by linkage 124 from neutral to winch-hoist position. Such movement causes port 116 of winch motor 34 to become pressurized and the motor begins rotation in the winch-hoist direction. It is to be noted that such movement of control lever 122 does not result in any movement of brake valve spool 106 because the spool is not movable outwardly beyond its brake-applied position. However, slot 186 in plate 184 of linkage 124 permits plate 184 to move clockwise sufficiently with respect to pin 186 to allow for inward movement of valve spool 118 of control valve 112. Since, brake valve 98 is still in brake-applied condition, brake cylinder 80 remains depressurized and the brake pads 78 still engage brake disc 72. However, uni-directional clutch 74 between brake disc 72 and motor shaft 36 and drive shaft 38, allows both these shafts to rotate in the winch-hoist direction despite the fact that the brake is still applied. Further movement of control lever 122 in the winch-hoist direction causes an increase in the speed of winch motor 44. Reverse movement of control lever 122 (short of a full return to neutral) results in a decrease in the speed of drum rotation. When control lever 122 is returned to neutral, linkage 124 causes valve spool 118 of control valve 112 to return to neutral and effect depressurization of port 116 of motor 34. Subsequent to this, linkage 124 effects return movement of valve spool 106 of brake valve 98 to brake-applied position, depressurization of brake cylinder 80, and re-engagement of the brake pads 78 with brake disc 72 to brake winch 12.

The invention allows for a smooth transition in winch drum speed during a lowering operation. The linkage provides compact, simplified, positive control for the two valves being operated. The fluid supply for the brake valve and brake cylinder are separate from the fluid supply for the control valve and winch motor so that loss of pressure in one does not affect operation of the other.

I claim:
1. A crane having a main frame, a boom pivotally mounted on said frame for vertical swinging relative thereto, said boom comprising a plurality of telescoping boom sections for changing the length of the boom, a winch on said frame, a load line connected to said winch and trained over a free end of said boom for engaging a load, said winch comprising, a shaft, a hydraulic motor for driving said winch through said shaft in winch hoist and winch lower directions, a unidirectional clutch on said shaft, and hydraulic brake means for said winch connected to said unidirectional clutch means, said brake means having brake-applied and brake-release positions, said unidirectional clutch means enabling said winch to be operated in the hoist direction when said hydraulic brake means are in brake applied position and enabling braking of said winch when the latter is operated in the lower direction and said hydraulic brake means are in brake applied position, control valve means for said motor, brake valve means for said brake means, and control means for operating said control valve means and said brake valve means, said control means including a movable control lever connected to and for operating both said valve means, said control lever being operable in the winch-lower direction to effect operation of said brake means and release of said brake means to effect subsequent operation of said control valve means and operation of said motor in the winch-lower direction.

2. A combination according to claim 1 wherein said control means for operating said valve means are operable in the winch-hoist direction to effect operation of said control valve means and effect operation of said motor in the winch-hoist direction while permitting said brake valve means and brake means to remain in the brake-applied positions.

3. A combination according to claim 2 wherein said control means for operating said valve means comprises a movable control lever and a linkage connected between said control lever and said control valve means and said brake valve means.

4. A crane having a main frame, a boom pivotally mounted on said frame for vertical swinging relative thereto, said boom comprising a plurality of telescoping boom sections for changing the length of the boom, a winch on said frame, a load line connected to said winch and trained over a free end of said boom for engaging a load, said winch comprising, a shaft, a hydraulic motor for driving said winch through said shaft in winch hoist and winch lower directions, a unidirectional clutch on said shaft, and hydraulic brake means for said winch connected to said unidirectional clutch means, said hydraulic brake means having brake-applied and brake-release positions, said unidirectional clutch means enabling said winch to be operated in the hoist direction when said hydraulic brake means are in brake applied position and enabling braking of said winch when the latter is operated in the lower direction and said hydraulic brake means are in brake applied position, control valve means for operating said motor in the winch-hoist and winch-lower direction, brake valve means for applying and releasing said brake means, and control means for operating both of said valve means, said control means comprising a control lever connected to both of said valve means and movable to winch hoist and winch lower directions, said control lever being operable in the winch-lower direction to effect operation of said brake valve means and release of said brake means prior to operation of said control valve means and operation of said motor in the winch-lower direction, said control lever being operable in the winch-hoist direction to effect operation of said control valve means and operation of said motor in the winch-hoist direction while said brake valve means and brake means remain in the brake-applied position.

5. A combination according to claim 4 wherein each of said valve means comprises a movable valve stem for effecting operation thereof and wherein said control means for operating said valves further comprises a linkage connected between said control lever and each valve stem.

6. A crane having a main frame, a boom pivotally mounted on said frame for vertical swinging relative thereto, said boom comprising a plurality of telescoping boom sections for changing the length of the boom, a winch on said frame, a load line connected to said winch and trained over a free end of said boom for engaging a load, said winch comprising, a shaft, a hydraulic motor for driving said winch through said shaft in winch hoist and winch lower directions, a unidirectional clutch on said shaft, and hydraulic brake means for said winch connected to said unidirectional clutch means, said hydraulic brake means having brake-applied and brake-release positions, said unidirectional clutch means enabling said winch to be operated in the hoist direction when said hydraulic brake means are in brake applied position and enabling braking of said winch when the latter is operated in the lower direction and said hydraulic brake means are in brake applied position, a control valve for said hydraulic motor having a neutral position, a winch-hoist position and winch-lower position, a brake valve for said brake cylinder having a brake-applied position and a brake-release position, a control lever for said control valve and for said brake valve, said control lever having a neutral position, a winch-hoist position and a winch-lower position, and a linkage comprising lost-motion connection means connected between said control lever and said control valve and said brake valve, said linkage, when said control lever is moved from neutral to lower position, effecting movement of said brake valve to brake-release position and subsequently effecting movement of said control valve to winch-lower position, and said linkage, when said control lever is moved from neutral to winch-hoist position, effecting movement of said control valve to winch-hoist position but permitting said brake valve to remain in brake-applied position.

7. A crane having a main frame, a boom pivotally mounted on said frame for vertical swinging relative thereto, said boom comprising a plurality of telescoping boom sections for changing the length of the boom, a winch on said frame, a load line connected to said winch and trained over a free end of said boom for engaging a load, said winch comprising, a shaft, a hydraulic motor for driving said winch through said shaft in winch hoist and winch lower directions, a unidirectional clutch on said shaft, and hydraulic brake means for said winch connected to said unidirectional clutch means, said hydraulic brake means having brake-applied and brake-release positions, said unidirectional clutch means enabling said winch to be operated in the hoist direction when said hydraulic brake means are in
brake applied position and enabling braking of said winch when the latter is operated in the lower direction and said hydraulic brake means are in brake applied position, said brake means comprising a brake and hydraulic brake cylinder connected to said brake and operable to effect release of said brake, a control valve for said hydraulic motor and comprising a movable valve stem having a neutral position, a winch-lower position and a winch-lower position, a brake-valve for said brake cylinder and comprising a movable valve stem having a brake-applied position and a brake-release position, said brake valve stem when in brake-release position effecting operation of said brake cylinder, a control lever connected to said control valve stem and to said brake stem, said control lever having a neutral position, a winch-lower position and a winch-lower position, and a linkage comprising lost-motion connection means connected between said control lever and said control valve stem and said brake valve stem, said linkage, when said control lever is in neutral position, maintaining said control valve stem in neutral position and said brake valve stem in brake-applied position, said linkage, when said control lever is moved from neutral to lower position, effecting movement of said brake valve stem to brake-release position and subsequently effecting movement of said control valve stem to winch-lower position, and said linkage, when said control lever is moved from neutral to winch-lower position, effecting movement of said control valve stem to winch-lower position but permitting said brake valve stem to remain in brake-applied position.

A crane having a main frame, a boom pivotally mounted on said frame for vertical swinging relative thereto, said boom comprising a plurality of telescoping boom sections for changing the length of the boom, a winch on said frame, a load line connected to said winch and trained over a free end of said boom for engaging a load, said winch comprising a hydraulic motor, a shaft driven by said motor, a winch drum and gear means connected between said shaft and said drum to effect rotation of said drum, brake means for said winch comprising a brake disc, a unidirectional clutch for connecting said disc to said shaft, a caliper brake assembly comprising brake pads for engagement with said disc, spring means for normally biasing said pads against said disc, and a hydraulic brake cylinder pressurizable to release said pads from said disc, a three-position control valve for said motor and comprising a spool having a neutral position, a hoist position and a lower position, a source of pressurized hydraulic fluid for said control valve, a two-position brake valve for said brake cylinder and comprising a spool having a brake-closed position and a brake release position, a source of pressurized hydraulic fluid for said brake valve, control means for said valves comprising a control lever and a member pivotably movable thereby, said member having first and second arms and being movable about a point in response to movement of said control lever, first and second pins on said first and second arms, respectively, a first link pivotably connected between said first pin and the spool of said control valve, said first link being provided with a slot in which said first pin is engaged, a second link pivotably connected between said second pin and the spool of said brake valve, said second link being provided with a slot in which a pin on said brake valve spool is engaged, a stop projection on said second link engageable with said second arm, and a biasing spring connected between said second link and said hub.

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