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(54) VEHICLE SUPPORTED WINCH

(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, State of 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 is concerned with vehicles of the kind which have a drum, which in use is power-driven, for winding in and releasing a cable or like flexible member and in which the drum is driven and controlled by means of fluid pressure-operated clutches and a fluid pressure-operated brake.

One such winch, which is described in our British Specification No. 1,419,742 has a drum which is driven by an engine through a drive train having a normally disengaged input clutch which engages in response to fluid pressure to wind in the cable. The drive train also includes a normally engaged brake which immobilises the winch drum but which releases in response to fluid pressure in other modes of operation. Also, a conventional one-way sprag clutch allows the drum to be rotated to wind in the cable without releasing the normally engaged brake. In addition to the "Brake-On" and "Reel-In" or "Wind-In" modes of operation, the brake alone may be pressurized to effect a Brake-Off mode in which tension in the cable turns the drum to unwind cable against the limited resistance created by the drag of the drive train components. This limited resistance prevents excess unwinding of cable by tension in the cable produced by a load, by drum momentum or other causes, but is sufficiently strong to make it difficult or impossible to withdrawn cable manually while the resistance is present. Accordingly, the drive train is itself connected to the winch drum through a disconnect clutch which is normally engaged but which may be disengaged by fluid pressure to allow

manual unwinding of cable from the drum without working against a substantial resistance. This is called a "Free-Spool" mode of operation. This form of winch is highly useful on a log skidder vehicle, for example, which is used to drag logs from the site of a lumbering operation and also has substantial advantages in other contexts.

Our British Specification No. 1,420,054 discloses a hydraulic control system for a winch of the kind described above in which a manually-operated control valve may be shifted between a series of positions to pressurize and depressurize as appropriate clutches and a brake of the drive train in order to accomplish the several operational modes described above. The valve settings include Reel-In, Brake-On, Brake-Off and Free-Spool and are achieved by movement of a control lever or the like. For safety reasons as well as for convenience of operation, centring springs urge the control valve towards the Brake-On position so that if the operator releases the control lever or the like, the winch is automatically immobilized.

The operator of these winches must pay careful attention to the position of his control lever or the like in order to control movement of a load in a safe and efficient manner. It is particularly important to avoid movement of the lever into the Free-Spool position through misjudgment while a load is pulling on the cable since momentum of the drum and over-travel may cause an excessive amount of cable to be released, creating unwanted slack, when dropping of the load stops or slows. Diversion of the operator's visual attention in order to guard against this occurrence is undesirable in many cases, particularly in such uses as on a log skidder where the operator must pay attention to controlling the vehicle itself in addition to operating the winch.

In order to guard against inadvertent movement of the control lever into the Free-Spool position, the lever has usually

been constrained to pivot along a slot in a console which includes an angled section whereby sideways movement of the control lever is needed before the lever movement can be continued into the Free-Spool position from the adjusted position. This arrangement accomplishes the objective of alerting the operator when the lever approaches the Free-Spool position but it also undesirably complicates lever manipulation and delays shifting into the Free-Spool mode at a time when fast action may be required.

Our British Specification No. 1,491,831 discloses a winch having a plurality of modes of operation, including a Free-Spool mode in which there is little resistance to turning of the winch drum, and these modes are initiated by movement of a single control lever. Means are provided which enable the operator to determine when the control lever is approaching the Free-Spool position without necessarily relying on visual observation for this purpose and without complicating the lever movement pattern.

Generally when the winches are supported on vehicles, the winches have had the drums thereof driven by means for selectively transmitting rotation to them via an input shaft or the like which is itself driven by a driving engine of the vehicle. This has created a serious problem especially with articulated vehicles in which the winch is carried by a trailer which follows a tractor of the vehicle which contains the engine. The problem has been in maintaining a direct drive of the winch input shaft by the engine as the parts of the vehicle, i.e., the trailer and the tractor, move relative to one another.

It is now proposed to provide vehicle supported winch wherein a source of pressurized fluid which operates the clutches and the brake of the winch comprises pump means driven from the transmission of the vehicle rather than more directly by the engine of the vehicle, so that in the case of an articulated vehicle the coupling of the pump means to the transmission may be on the trailer side of the articulation thus eliminating coupling problems between the input shaft and the engine of the tractor.

The use of a drive from the transmission to the pump means, however, introduces another problem, namely, that the transmission can slow down and even stall as it is subjected to heavy loads even though the engine continues to turn. This is especially true with fluid transmissions. If this happens, the pump means is no longer driven and the fluid pressure supply to the winch clutches and brake fails.

According to this invention, a winch is mounted on a vehicle and comprises a rotatable drum which is arranged to be power-driven or released for winding in or releasing

a cable or like flexible member means, means for selectively transmitting a rotary drive to the drum, the drive transmitting means including a normally disengaged input clutch which engages to transmit the drive on application of fluid pressure thereto, a normally engaged brake which is connected to the drive transmitting means through a one-way clutch so that it stops rotation of the drive transmitting means on the driven side of the input clutch and hence stops the drum from rotating in a direction to release cable but allows rotation in a direction to wind in cable, the brake being released on application of fluid pressure thereto, and a normally engaged disconnect clutch which disengages the drum from the drive transmitting means and from the brake on application of fluid pressure thereto, a source of pressurized fluid, first means communicating with the source for selectively controlling the application of fluid pressure to the input clutch, second means communicating with the source for selectively controlling the application of fluid pressure to the brake and third means communicating with the source for selectively controlling the application of fluid pressure to the disconnect clutch, the first, second and third means providing a Brake-On condition in which the input clutch, the brake and the disconnect clutch are unpressurized, a Reel-In condition in which only the input clutch is pressurized, and a Brake-Off condition in which only the brake is pressurized, wherein the source of pressurized fluid comprises pump means in combination with a hydraulic accumulator communicating with the pump means, the pump means being driven by a transmission of the vehicle so that it stops when the transmission stalls, the accumulator storing fluid under pressure from the pump means when the pump is driven and supplying fluid under pressure to the first, second and third means when the pump is stopped.

Thus, the advantages of driving the pump means by the transmission can be realized without the disadvantages which would be inherent therein without the use of the accumulator.

An example of a winch in accordance with the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic side view of an articulated vehicle with the winch mounted on it;

Figure 2 is a hydraulic circuit diagram of the winch, the clutches and brakes therefor, and means for selectively transmitting rotary motion to the winch drum along with means for driving a pump therefrom;

Figure 3 illustrates diagrammatically a control for the winch;

Figure 4 is a hydraulic circuit diagram

illustrating a control system operated by the control of Figure 3;

Figure 5 is a section of the control as seen in the direction of the arrows on the line V—V of Figure 3;

Figure 6 is a view similar to that of Figure 5 but taken along the line VI—VI of Figure 3;

Figure 7 is a view similar to those of Figures 5 and 6 but taken along the line VII—VII of Figure 3;

Figure 8 is a view similar to those shown in Figures 6, 7 and 8 but taken along the line VIII—VII of Figure 3; and,

Figure 9 is a graph illustrating the operation of the winch of the present invention in its various operational conditions.

The winch described with reference to the drawings was developed for use on an articulated vehicle, with the winch on the back thereof and is therefore described in this particular context for purposes of example, it being apparent that the winch may also be employed on various other forms of load-manipulating vehicles. Referring initially to Figure 1, an articulated vehicle 10, which may be used in lumbering operations or the like primarily for dragging heavy logs away from the site of tree-cutting operations, is illustrated. For this purpose, the vehicle is provided with a rotatable winch drum 12 having a length of cable 14 wound thereon.

As is understood by those skilled in the art, it is necessary at times to immobilize the winch drum 12 so that the vehicle may be used to drag a log while at other times the cable 14 must be reeled in by driving the drum. In the embodiment of the present invention, the drum 12 is driven by a transmission 16 which is itself driven in the usual manner by an engine 18 of the vehicle 10. Generally, the transmission 16 drives the winch drum 12 via universal joint 20 from which extends an input shaft 22.

As is further understood by those skilled in the art, there are times when it is necessary to release some of the cable 14 from the winch drum 12. If the cable is to be withdrawn from the drum by the weight of the load pulling on the cable, it is desirable that there be some limited resistance to drum rotation. Such resistance prevents overly fast or erratic release of cable and prevents momentum from causing an excess amount of cable to be released when load movement slows or stops.

Referring now to Figure 2 of the drawing primarily, there is illustrated therein means for selectively transmitting rotary motion to the winch drum 12 from the transmission 16. Specifically, the input shaft 22 from the transmission 16 guided by bearings 24 causes a first gear 26 to rotate. The first gear 26 is drivingly connected to a

second gear 28 supported by bearing means 30. As the second gear 28 rotates under the impetus of the first gear 26, this causes a first shaft 32 to rotate a normally disengaged friction input clutch 34. On application of fluid pressure to the input clutch 34, it drivingly engages with a second shaft 36. The second shaft 36 from the clutch 34 is coupled with a clutch output gear 38, which is secured for rotation with a transfer gear 40. The clutch output gear 38 meshes with a brake gear 42 while a normally engaged friction brake 44 is operable to secure the brake gear 42 against rotation. A conventional one-way sprag clutch 41 allows the drum to be rotated to wind in cable 14 without releasing brake 44. A normally disengaged viscous brake 46, which engages on application of fluid pressure thereto, is provided, which acts upon the brake gear 42 to provide a viscous drag in the Free-spool position, thus preventing free unwinding of the cable 14 from the winch drum 12, when the winch drum 12 is not being powered to rotate.

The components described above in engagement with the input shaft 22 comprises an intermediate portion of the drive train. The normally disengaged input clutch 34 permits driving operation of the gear components within the intermediate drive train by the input shaft 22. The normally engaged brake 44 in one mode of operation tends to be disengaged as the clutch 34 is engaged or conversely, tends to be engaged as the clutch 34 is disengaged. Thus, the brake 44 serves to prevent rotation of the intermediate drive train for at least those components on the output side of the clutch 34 when it is disengaged. In this connection, the hydraulic control system described below is adapted to selectively operate the brake 44 and the clutch 34 in opposition with each other or to operate the brake 44 alone, the control system having hydraulic control valve means with modulating means particularly adapted for operation of the brake 44 and the clutch 34.

An output portion 50 of the winch drive train includes a second transfer gear 52 arranged in meshing engagement with the first transfer gear 40. The second transfer gear 52 is mounted upon a third shaft 54 for a bevel gear assembly 56 having bevel gears 58 and 60. A winch drum shaft 62 provides an output for the bevel gear assembly 56 with the winch drum 12 being arranged for rotation upon the shaft 62 by means of bearings 63.

A jaw-type disconnect clutch 64 is normally engaged to provide a coupling between the winch drum shaft 62 and the winch drum 12 while being selectively disengageable to permit entirely free rotation of the winch drum 12. Referring momentarily to

Figure 1, it may be seen that the cable 14 is entrained about the winch drum 12 for operation in conjunction with an arch 66. The above discussed components and their interactions are described in more detail in previously mentioned Specification No. 1,491,831.

As will be further noted by reference to Figure 2, pump means, in particular a hydraulic pump 68, is driven by the intermediate portion 48 of the winch drive train. More particularly, the pump 68 is driven by a pump shaft 70, which rotates in bearings 72 and is driven by a pump gear 74, which meshingly engages with the second gear 28. It is clear from the arrangement set out in Figure 2 that the pump 68 is thus driven by the transmission 16 and is in fact directly driven thereby via the first gear 26, the second gear 28 and the pump gear 74. Further, it is clear that the hydraulic pump 68 is driven by the transmission 16 in a continuous manner and that such driving is not interrupted when the clutch 34 is disengaged, the brake 44 is applied or the clutch 64 is disengaged. It follows that the pump 68 will then only cease to pump hydraulic fluid if the transmission 16 stalls or if it is shut off in some manner not shown in Figure 2.

Referring now to Figures 3—8, there is illustrated control valve means 76 generally in Figures 3 and 4 and by specific parts thereof in Figures 5—8. Also illustrated in Figures 4 and 5 is an improved pressurized fluid source 78 comprising the aforementioned hydraulic pump 68 driven by the transmission 16 and an accumulator 80 which communicates with the pump 68 via a conduit 82 a passage 84, a check valve 86 and an accumulator passage 88.

Operationally, the pump 68, driven by the transmission 16, supplies fluid via the conduit 82 to the passage 84. The passage 84 then separates into three branches, a first branch 84A leading off to a restrictive orifice 90 and thence being continuously routed to lubricate the vehicle supported winch. The path of continuous routing comprises a passage about an undercut 92 shown in Figure 6 in a control body 94 and more particularly in a bore 96 within said control body 94 and in which a control spool 98 is movable in a way later explained. The flow from the undercut 92 proceeds via a continuation 84A¹ of passage 84A as shown in Figures 6 and 7 and thence about an undercut 100 in a viscous brake spool 102 and finally via a further continuation 84A¹¹ of passage 84A to lubricate the winch and then be returned to the pump 68.

A second portion of the fluid being pumped by the pump 68 leaves the passage 84 via a second branch thereof 84B. This is shown most clearly in Figure 5. The

passage 84B then takes the second portion of fluid from the pump 68 and delivers it as shown in Figure 6 to an undercut 104 in the bore 96 of the control spool 98. In certain modes of operation, as will be explained in the following, the control spool 98 is shifted responsive to pressure being applied in a pressure cavity 106 thereof sufficiently so that the fluid from the pump being delivered via passage 84B proceeds from the undercut 104 to the undercut 92 and thence via the passage 84A¹ to lubricate the winch along with the first portion of fluid from the pump 68 which has passed through the orifice 90 and directly into the undercut 92. A pressure relief valve 108 controls the total amount of pressure which can be sent to lubricate the winch by providing an escape means to a sump 109 of the pump 68 when the pressure of the fluid in the passage 84A¹ exceeds a selected value, for example 50 psi or the like.

The passage 84 divides into a third branch 84C as illustrated in Figure 5 and there impinges upon the check valve 86. The check valve 86 allows passage therethrough only when a sufficient pressure differential exists in the passage 84C and the fluid in the accumulator 80 so as to move the check valve 86 against the action of a spring 110.

A logic slug 112 shown in Figure 6 controls the operation of the control spool 98 in a way which will soon be apparent. As will be noted, the accumulator passage 88, which is maintained at pressure by the accumulator 80, communicates with narrowed portion 114 of a sleeve 116 which is coaxial with the logic slug 112. The fluid pressure from the accumulator passage 88 is thus applied to the bore 118. From the bore 118 the pressure in the accumulator passage is also applied via a port 120 to a smaller diameter portion 122 of the logic slug 112. Because of the pressure being applied to the smaller diameter portion 122 of the logic slug 112, the logic slug 112 is forced against a spacer 124 and thereby against a spring 126. As the logic slug 112 moves towards the spring 126 and compresses it, a pressure cavity passage 128, which extends between the pressure cavity 106 and the bore 118, is cut off from draining via an opening 130, a cross bore 132 in the logic slug and a spacer bore 134. As this cut off in draining of the pressure cavity passage 128 occurs, or shortly thereafter, the pressure in the accumulator 80, which is exactly the same as pressure within the accumulator passage 88, is applied to a larger diameter portion 136 of the logic slug 112. This occurs since the pressurized fluid in the accumulator passage 88 passes first through the port 120, then up a bore 138 and through a hole 140 to an undercut 142 and thence is applied against the larger diameter por-

tion 136 of the logic slug 112. The accumulator pressure or more specifically, the pressure within the accumulator passage 88 is likewise applied at the same time via the port 120, the bore 138, the hole 140, the opening 130 and the pressure cavity passage 128 to the pressure cavity 106 of the control spool 98. Two things result as a consequence of the application of the fluid pressure in the accumulator passage 88 to the undercut 142. First, the logic slug 112 is urged quickly against the force exerted by the spring 126. Second, the pressure cavity 106 begins to fill, thus forcing the control spool 98 against the retaining force of a spring 144. This continues until sufficient pressure exists in the pressure cavity 106 to connect the undercut 92 with the undercut 104, whereby flow of fluid from the pump 68 via the passageway 84B occurs to lubricate the winch as previously described. Because of this relief means for the pressure produced by the pump 68, said pump can operate continuously and does not have to be shut off once the accumulator has been charged to its full operating pressure. As pressure drops in the accumulator 80 and hence in the accumulator passage 88, the logic slug 112 is propelled by the spring 126 until the pressure cavity 106 is open to drain as previously described. At that time, pump flow from the pump 68 is once again routed to the accumulator 80 via the check valve 86 and the cycle just described begins anew.

The accumulator pressure is also applied to a modulating control spool 146, illustrated most clearly in Figure 7. The pressure is applied via the accumulator passage 88 and the bore 118 about the sleeve 116. The direction of application of the pressure in the accumulator passage 88 is controlled by movement of a control shift spool 148, which can be manually adjusted towards and away from the modulating control spool 146, and which communicates with the modulating control spool 146 via a modulating spring 150. As the control shift spool 148 is moved towards the modulating control spool 146, this forces the modulating control spool 146 via the spring 150 downwardly in Figure 7. Eventually, the modulating control spool 146 closes off the connection between a brake drain passage 152 and the brake 44, which normally proceeds via a cross bore 154 and an axial bore 156 of the modulating control spool 146. Very simply, a shoulder 158 of the modulating control spool 146 shuts off contact between an undercut 160 within a bore 162 of the modulating control spool 146 and the cross bore 154 leading to the axial bore 156 of the modulating control spool 146. The brake 44, as will be noted, normally drains via a brake passage 164 to a lower

cavity 166 of the bore 162. Pressure on the brake 44 will modulate between a lower and an upper limit, for example, between 75 and 200 psi depending on the distance that the control shift spool 148 is moved downwardly. After moving a specific distance downwardly, the control shift spool 148, or more particularly, a flange 168 extending radially therefrom, contacts a washer 170 and thus meets the resistance of a heavy spring 172. An operator moving the control shift spool 148 can immediately feel the change in resistance to movement of the control shift spool 148. The control shift spool 148 is at the time of contact of the flange 168 with the washer 170 in its maximum modulating position for the Brake-Off position at which only the brake 44 is pressurized. In this situation, the brake 44 is pressurized via the pressure in the accumulator passage 88, which passes first to an undercut 174 and thence via the cross bore 154 and the axial bore 156 to the brake 44. The brake 44 being normally engaged thus starts to become disengaged as pressure is applied thereto and it is prevented from draining via brake drain passage 152. The control shift spool 148 can then be moved an additional space downwardly, allowing pressure to build up within the brake 44 fully to the pressure within the accumulator passage 88. This pressure is likewise applied to a disconnect spool 176 via a disconnect passage 178 (Figure 8). This pressure causes the disconnect spool 176 to move against the biasing of a spring 180 until eventually flow connection is completed with an undercut 182 leading to pressurization of the disconnect clutch 64 via a passage 184. When the control shift spool 148 is released, the springs acting on the various spools force them back to their original positions and the disconnect clutch 64, as well as the friction brake 44, connect to drain.

It will be further noted that as the control shift spool 148 moves upwardly, the modulating control 146 will eventually close a Reel-In drain passage 186, and thereafter will open a Reel-In passage 188 to the accumulator passage 88 via the undercut 174, and an undercut 190 in the bore 162, and further via a modulating spool undercut 192 in the modulating control spool 146. This thus leads to pressurization of the Reel-In clutch, i.e., the input clutch 34. There is no modulation obtained in this operation. When the control shift spool 148 is released, the modulation control spool 146 is returned to its original position by the springs acting upon it and upon the control shift spool 148, thus allowing the Reel-In or input clutch 34 to drain.

The viscous brake 46 is engaged by pressure from the passage 84A¹. As will be

remembered; this passage also leads to lubrication of the winch. When the winch is working, i.e., reeling in, brake on, modulating brake pressure, or in disconnect mode, either a viscous brake slug 194 is pressurized via the disconnect passage 178, or a cavity 196 between the viscous brake slug 94 and the viscous brake spool 102 is pressurized via the reel-in passage 188. The presence of pressure at either of these places causes the viscous brake spool 102 to move upwardly against a spring 198 eventually closing off the viscous brake to pressure in passage 84A¹ when a shoulder 200 closes to a bore 202. Thus, the viscous brake 46 is off whenever the winch is operating and is on only in the Free-spool position.

It is clear then that what is provided is a Brake-On position at which the input clutch 34, the brake 44, the viscous brake 46 and the disconnect clutch 64 are unpressurized, a Reel-In position at which only the input clutch 34 is pressurized, and a Brake-Off position at which the brake 44 and the viscous brake 46 are pressurized.

As is further clear, the inclusion of the accumulator 80 makes possible the functioning of the system when functioning of the pump 68 is retarded as, for example, when the transmission 16 of the vehicle stalls. The normally disengaged viscous drag brake 46 is disengaged in the Brake-on, disconnect, and Reel-In positions.

Figure 9 graphically illustrates the operation of modulating control spool 146 as a function of control shift spool 148 at various fluid pressures. Brake modulation, with shifting of control shift spool 148, is seen from spool travel of about 0.13 inch to about 0.5 inch.

WHAT WE CLAIM IS:—

1. A winch which is mounted on a vehicle and comprises a rotatable drum which is arranged to be power-driven or released for winding in or releasing a cable or like flexible member, means for selectively transmitting a rotary drive to the drum, the drive transmitting means including a normally disengaged input clutch which engages to transmit the drive on application of fluid pressure thereto, a normally engaged brake which is connected to the drive transmitting means through a one-way clutch so that it stops rotation of the drive transmitting means on the driven side of the input clutch and hence stops the drum from rotating in a direction to release cable but allows rotation in a direction to wind in cable, the brake being released on application of fluid pressure thereto, and a normally engaged disconnect clutch which disengages the drum from the drive transmitting means and from the brake on application of fluid pressure thereto, a source of

pressurized fluid, first means communicating with the source for selectively controlling the application of fluid pressure to the input clutch, second means communicating with the source for selectively controlling the application of fluid pressure to the brake and third means communicating with the source for selectively controlling the application of fluid pressure to the disconnect clutch, the first, second and third means providing a Brake-On condition in which the input clutch, the brake and the disconnect clutch are unpressurized, a Reel-In condition in which only the input clutch is pressurized, and a Brake-Off condition in which only the brake is pressurized, wherein the source of pressurized fluid comprises pump means in combination with a hydraulic accumulator communicating with the pump means, the pump means being driven by a transmission of the vehicle so that it stops when the transmission stalls, the accumulator storing fluid under pressure from the pump means when the pump is driven and supplying fluid under pressure to the first, second and third means when the pump is stopped.

2. A winch according to claim 1, further comprising a normally disengaged viscous drag brake, which engages on application of fluid pressure thereto to create a drag on the drum opposing unwinding of the cable or like flexible member, and fourth means communicating with the source for selectively controlling the application of fluid pressure to the viscous drag brake.

3. A winch according to claim 1 or claim 2, wherein the fluid supplied by the source comprises a lubricant and the winch further comprising means for continuously feeding a first portion of the fluid to lubricate the winch, and means for intermittently feeding a second portion of the fluid away from the accumulator to lubricate the winch in response to the fluid pressure in the accumulator reaching a preselected value.

4. A winch according to claim 3, in which the first, second and third means comprise a control valve including a valve body having a fluid inlet passage connected to the pump means, a first branch passage in communication with the continuous feeding means via a restricted orifice through which, in operation, the first portion of the fluid flows, a second branch passage in communication with a valve spool which directs the second portion of the fluid to the intermittent feeding means when the fluid pressure in the accumulator reaches the preselected value, a third branch passage communicating via check valve means with the accumulator, a fluid logic slug which is arranged to receive fluid under pressure from the accumulator, to deliver the fluid to move the valve spool, when the fluid pressure in the accumulator reaches the preselected

(12)



remembered, this passage also leads to lubrication of the winch. When the winch is working, i.e., reeling in, brake on, modulating brake pressure, or in disconnect mode, either a viscous brake slug 94 is pressurized via the disconnect passage 178, or a cavity 196 between the viscous brake slug 94 and the viscous brake spool 102 is pressurized via the reel-in passage 188. The presence of pressure at either of these places causes the viscous brake spool 102 to move upwardly against a spring 198 eventually closing off the viscous brake to pressure in passage 84A¹ when a shoulder 200 closes to a bore 202. Thus, the viscous brake 46 is off whenever the winch is operating and is on only in the Free-spool position.

It is clear then that what is provided is a Brake-On position at which the input clutch 34, the brake 44, the viscous brake 46 and the disconnect clutch 64 are unpressurized, a Reel-In position at which only the input clutch 34 is pressurized, and a Brake-Off position at which the brake 44 and the viscous brake 46 are pressurized.

As is further clear, the inclusion of the accumulator 80 makes possible the functioning of the system when functioning of the pump 68 is retarded as, for example, when the transmission 16 of the vehicle stalls. The normally disengaged viscous drag brake 46 is disengaged in the Brake-on, disconnect, and Reel-In positions.

Figure 9 graphically illustrates the operation of modulating control spool 146 as a function of control shift spool 148 at various fluid pressures. Brake modulation, with shifting of control shift spool 148, is seen from spool travel of about 0.13 inch to about 0.5 inch.

WHAT WE CLAIM IS:—

1. A winch which is mounted on a vehicle and comprises a rotatable drum which is arranged to be power-driven or released for winding in or releasing a cable or like flexible member, means for selectively transmitting a rotary drive to the drum, the drive transmitting means including a normally disengaged input clutch which engages to transmit the drive on application of fluid pressure thereto, a normally engaged brake which is connected to the drive transmitting means through a one-way clutch so that it stops rotation of the drive transmitting means on the driven side of the input clutch and hence stops the drum from rotating in a direction to release cable but allows rotation in a direction to wind in cable, the brake being released on application of fluid pressure thereto, and a normally engaged disconnect clutch which disengages the drum from the drive transmitting means and from the brake on application of fluid pressure thereto, a source of

pressurized fluid, first means communicating with the source for selectively controlling the application of fluid pressure to the input clutch, second means communicating with the source for selectively controlling the application of fluid pressure to the brake and third means communicating with the source for selectively controlling the application of fluid pressure to the disconnect clutch, the first, second and third means providing a Brake-On condition in which the input clutch, the brake and the disconnect clutch are unpressurized, a Reel-In condition in which only the input clutch is pressurized, and a Brake-Off condition in which only the brake is pressurized, wherein the source of pressurized fluid comprises pump means in combination with a hydraulic accumulator communicating with the pump means, the pump means being driven by a transmission of the vehicle so that it stops when the transmission stalls, the accumulator storing fluid under pressure from the pump means when the pump is driven and supplying fluid under pressure to the first, second and third means when the pump is stopped.

2. A winch according to claim 1, further comprising a normally disengaged viscous drag brake, which engages on application of fluid pressure thereto to create a drag on the drum opposing unwinding of the cable or like flexible member, and fourth means communicating with the source for selectively controlling the application of fluid pressure to the viscous drag brake.

3. A winch according to claim 1 or claim 2, wherein the fluid supplied by the source comprises a lubricant and the winch further comprising means for continuously feeding a first portion of the fluid to lubricate the winch, and means for intermittently feeding a second portion of the fluid away from the accumulator to lubricate the winch in response to the fluid pressure in the accumulator reaching a preselected value.

4. A winch according to claim 3, in which the first, second and third means comprise a control valve including a valve body having a fluid inlet passage connected to the pump means, a first branch passage in communication with the continuous feeding means via a restricted orifice through which, in operation, the first portion of the fluid flows, a second branch passage in communication with a valve spool which directs the second portion of the fluid to the intermittent feeding means when the fluid pressure in the accumulator reaches the preselected value, a third branch passage communicating via check valve means with the accumulator, a fluid logic slug which is arranged to receive fluid under pressure from the accumulator, to deliver the fluid to move the valve spool, when the fluid pressure in the accumulator reaches the preselected

- value, into a position in which the spool routes the second portion of the fluid to lubricate the winch and to provide a path for the fluid delivered to move said control
- 5 spool when said accumulator pressure reaches said preselected value and a control member for shifting a control shift spool, the member being positionable to provide the Brake-On, Reel-In and Brake-Off con-
- 10 ditions.
5. A winch according to claim 4 when dependent on claim 2, wherein the fourth means comprises viscous spool means which moves in response to operation of the winch
- 15 with the control shift spool in a position to

provide the Brake-On, or Reel-In conditions to drain the viscous drag brake and moves to apply fluid pressure to engage the viscous drag brake in a Free-spool Brake-off condition.

6. A winch according to claim 1, substantially as described with reference to the accompanying drawings.

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