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AUTOMATIC MOORING WINCH

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Fig. 1.

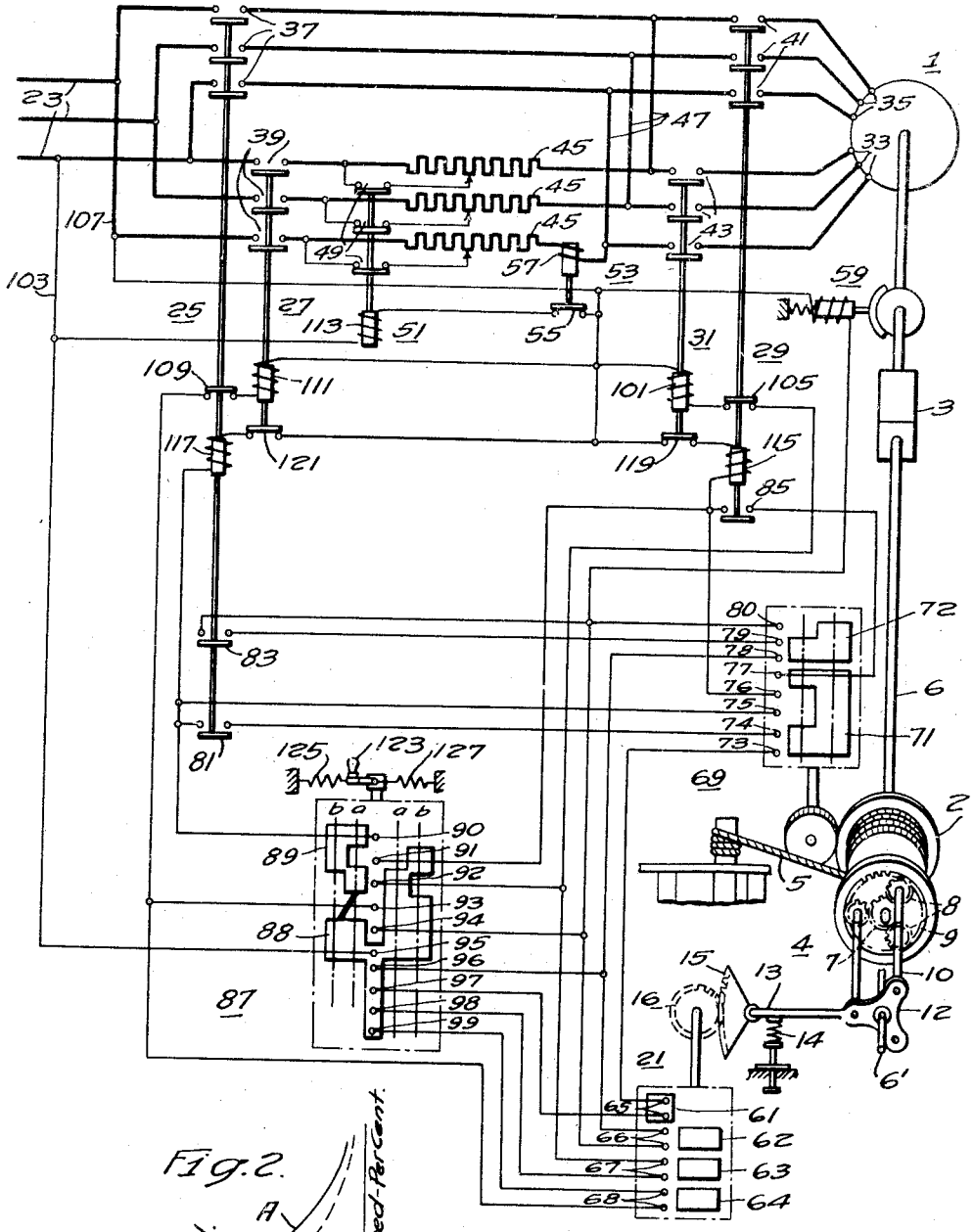
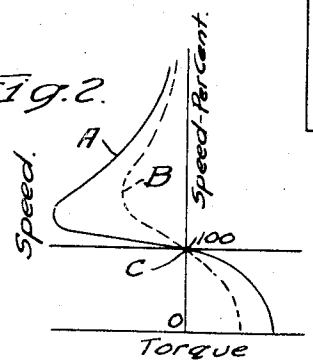


Fig. 2.



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AUTOMATIC MOORING WINCH

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9 Claims. (Cl. 254—172)

My invention relates to automatic mooring and towing winch control systems, and particularly to a control system for a mooring or towing winch employing a squirrel cage motor drive.

One object of my invention is to provide an automatic control system for a mooring or towing which, whereby the winch will be operated to pay out the mooring or towing cable as may be necessary, in order to maintain the cable tension at or below a predetermined magnitude and to heave in when the effective lengths of the cable exceed a predetermined magnitude.

When the winch is to be used on a ship, such as a tanker, carrying explosive materials, it is desirable that the motor for the winch shall be free of any operation that might generate a spark or an arc. A squirrel cage induction motor is therefore preferred for those applications, since it is free of collector rings or commutating devices on which arcs or sparks might develop during operation.

A further object of my invention, therefore, is to provide an automatic control system for a winch employing a squirrel cage motor.

In a system of this type in which a squirrel cage motor is employed, a problem is encountered when the cable tension exceeds the motor torque and tends to overhaul the motor. Under such conditions no energy is taken by the motor from the energizing circuit and the torque developed in the motor by its energizing current becomes zero. Under such conditions the motor tends to hold its equivalent synchronous speed constant up to extremely high torque values that may reach 600% of full load torque before permitting the speed of the motor to be increased to pay out cable in response to increased tension in the cable.

If the motor speed is kept constant in spite of the greatly increased torque and increased tension in the cable, an unnecessary and excessive stress is imposed upon the cable that may cause it to break.

Another object of my invention, therefore, is to provide for the modification of the normal torque that would be developed in the squirrel-cage motor under overhauling conditions, in order to enable the motor to increase its speed during such overhauling conditions to compensate more readily for the increased cable tension.

From the nature of the operation desired in a winch, the automatic control for the winch should be such as to avoid hunting. For that reason, I prefer to employ a squirrel-cage motor provided with two sets of windings, one for high speed, and one for low speed operation. The usual automatic adjustments of the cable length by the winch to modify or change the cable tension when the tension is above a predetermined magnitude will be taken care of by the slow speed operation of the motor in pay-out direction of rotation. Automatic reclaiming of the cable will be taken care of by the high speed operation of the motor in the heave-in direction of rotation. The high speed operation, as well as the low speed operation, will also be made available for use whenever the winch is to be operated manually, so that maximum flexibility of control may be achieved between the two speeds.

Among the other objects of my invention, therefore, are to provide a control system that will not hunt, and cause pumping or excessive reversal operation of the control system in the regulating action to maintain the cable tension at or below a predetermined magnitude; to permit simple adjustments of the tension in the cable in such manner as always to insure a proper balance between the motor torque and the tension; and, further, to provide a control system that shall be simple in its arrangement and effective in operation.

The manner in which the control equipment is applied to control the operation of a multi-speed squirrel cage induction motor, in accordance with the principles of my invention, is illustrated in the accompanying drawing, in which,

Figure 1 is a simple diagram of connections of the mooring system according to my invention; and

Fig. 2 is a graph showing the torque speed curves of the motor under different conditions.

As schematically shown in Figure 1, a mooring winch comprises an operating motor 1 which operates a drum or cable reel 2 through a suitable speed reducer 3, and a planetary torque-measuring system 4, to control a mooring cable 5.

The low speed shaft 6 of the reducer 3 drives a sun gear or pinion 7 of the planetary system 4. Three planet gears 8 are disposed between the sun gear 7 and a ring gear 9. Each planet gear 8 is mounted upon a pin 10 of a spider 12 that is rotatably supported on an extension 6' of shaft 6 from the speed reducer. Since the spider 12 is rotatably supported, and, in turn, supports the planet gears 8, the torque reaction forces developed between the ring gear 9 and the planet gears 8 will be translated into a reaction force between the planet gears 8 and the

spider 12. That reaction force will be proportional to the torque or tension in the cable.

To measure that reaction force upon the spider 12, and thus to measure the cable tension, a reaction arm 13 is connected to the spider 12 to oscillate with the spider 12 about the central axis of the planetary system 4.

The reaction arm 13 is disposed to press against an adjustable spring 14, which may be adjusted to provide a control reaction pressure to control the permitted tension range within which the cable tension may vary.

The outer end of the torque arm 13 supports a segmental gear 15 to engage a pinion 16 on a shaft of an automatic control switch 21 of the drum controller type.

Energy for the motor 1 is derived from a suitable source (not shown) through conductors 23 and certain pairs of contact members of contactor switches numbered 25, 27, 29 and 31, respectively, which may be actuated to energize the motor according to the speed and the direction in which the motor is to function. The motor 1 is provided with two sets of windings 33 and 35 in order to establish a low speed or a high speed of operation, according to which set of windings is energized. By way of illustration, the low speed windings 33 may be arranged to provide 32 poles, and the high speed windings 35, which are to operate the motor at high speed, may be arranged to provide 6 poles. It will readily be understood that the two windings 33 and 35 may be replaced by a winding that may be selectively connected for two speed operation of the motor 1.

Contact members 37 of the contactor switch 25 are provided to energize the motor in such a direction as to cause it to rotate the drum to heave in, and contact members 39 of the switch 27 are provided to connect the motor to the circuit in such direction as to pay out the cable. Contact members 41 of the switch 29 are connected to the high-speed windings 35. Contact members 43 of the switch 31 are connected to the low speed winding 33. Each conductor of the circuit between the contact members 39 and 43 contains a resistor 45. Cross-connecting conductors 47 are provided between the conductors that connect the contact member 43 and the resistor 45, and the conductors that connect the contact members 37 and 41.

Contact members 49 of the contactor switch 51 are connected across a portion of each of the resistors 45. Means such as a current responsive relay 53 having contact members 55 and operating coil 57, is provided for controlling switch 51, in a manner to be described hereinafter. Operating coil 57 is connected in the motor circuit so as to be energized only when the motor 1 is energized for operation in the pay-out direction of rotation.

In order to hold the motor 1 and drum 2 against rotation by the cable 5 when the system is not operating and the motor is deenergized, a brake 59 is provided.

To control the automatic operation of the motor 1 in the pay-out direction of rotation, the tension drum controller 21, that is controlled by the reaction arm 13, is provided with four controller segments 61 to 64, inclusive, and with four sets of contact fingers 65 to 68, inclusive. When the tension drum controller 21 is in the neutral or "off" position, that is, when the cable tension is at or below a predetermined magnitude, segment 61 engages contact fingers 65, but each of the other contact fingers is disengaged.

The drum controller 21 is connected through the pinion 16 and the gear segment 15 to the reaction tension arm 13, on the winch, in such manner as to move the tension drum controller 21 to one terminal position or to the other, whenever the reaction arm 13 reaches a predetermined limit position in its movement in one direction or the other, according to the tension in the cable.

To control the automatic operation of the motor 1 in the heave-in direction of rotation, a reclaiming drum controller 69, responsive to the angular displacement of the drum 2 or to the length of cable 5 unwound from the drum, is provided. As illustrated in Fig. 1, provision is made to reclaim or heave-in when the tension is at or below a predetermined magnitude only if the cable pay-out has exceeded a certain length. The reclaiming is done at high speed, but it will be understood that reclaiming may be done at slow speed, or provision may be made for reclaiming at high speed and transferring to slow speed just prior to the end of the reclaiming cycle, if necessary, to avoid hunting. It will also be understood that the heave-in or reclaiming operation of the motor 1 may be effected as soon after any pay-out operation as the tension decreases below a predetermined magnitude.

Reclaiming controller 69 is provided with contact segments 71 and 72 and contact fingers 73 to 80, inclusive. Contact members 81 and 83 on "in" switch 25 and contact members 85 on "fast" switch 29 are provided and electrically connected to reclaiming controller 69 as shown, only when it is desired to initiate the heave-in operation after the length of cable unwound from the drum has exceeded a predetermined length.

In order to permit manual control of the motor 1, a drum controller 87 is employed. This controller is provided with interconnected contact segments 88 and 89, and with contact fingers 90 to 99 inclusive.

The contact fingers 96 to 99 inclusive, of the manual controller control the circuits through the automatic tension controller 21, and reclaiming controller 69, to enable the manual controller 87 to assume complete control of the system. When the manual controller 87 is in neutral or "off" position, the segment 88 bridges the contact fingers 95 to 99 inclusive.

When the cable tension increases above a predetermined magnitude, the reaction arm 13 will operate the tension controller 21 towards the left, and segments 62, 63 and 64 will engage and energize contact fingers 66, 67 and 68 respectively.

Contact fingers 67 and segment 63 control the circuit to operating coil 101 of "slow" contactor 31. That circuit extends from energized conductor 103, through contact fingers 95 and 98 and segment 88 of manual controller 87, contact fingers 67 and segment 63 of tension controller 21, back interlock 105 of "fast" contactor 29, operating coil 101 of "slow" contactor switch 31, to energized conductor 107. When the control circuit is thus completed, contactor 31 is actuated to close the circuit through contact members 43 connected to the slow windings 33 of the motor 1.

Contact fingers 68 and segment 64 control a circuit which may be traced from energized conductor 103 through contact fingers 95 and 99 and segment 88 of manual controller 87, contact fingers 68 and segment 64 of tension controller 21, back interlock switch 109 of "in" contactor 25,

and operating coil 111 of "out" contactor 27, to energized conductor 107. "Out" contactor 27 will thereupon be actuated to connect the slow speed windings 33 of the motor 1 through the contact members 39, the closed contact members 49 of contactor switch 51, a portion of the resistors 45, operating coil 57 of relay 53, and closed contact members 43 of the "slow" contactor 31 to the main circuit 23, to energize the slow speed windings 33 and to rotate the motor 1 slowly in a direction to pay out the cable to relieve the excessive tension developed therein.

At the same time, the brake 59 on the motor will be released or disengaged from the motor by the energization of the brake release coil through a circuit controlled by the contact fingers 66, which may be traced from energized conductor 103 through segment 83 and contact fingers 95 and 96 of controller 87, contact fingers 65 and contact segment 62, and the operating coil of the brake 59, to bus conductor 107.

If the resistors 45 were not provided in the circuit to the motor 1, the speed torque curve of the motor would be substantially as shown in the solid line curve A in Fig. 2. As shown on the right-hand side of the vertical ordinate base line, the speed drops off with an increase in torque in the forward driving direction, but the speed does not tend to increase very much in the negative torque direction which would correspond to the overhauling action by the cable. Because of such tendency of the motor to hold itself substantially at the speed corresponding to zero torque, an excessive tension would be developed in the cable because of the failure of the motor to rotate faster in response to the overhauling tendency of the cable. Such excess tension in the cable would be relieved if the motor speed could be increased. Since the development of such excessive stresses in the cable may break the cable, it is desirable to modify the motor action to enable it to respond more freely to the overhauling tendency of the cable.

In order to control the motor torque during overhauling so that the motor will permit the cable to readjust its tension more rapidly, a portion of resistors 45 are utilized and they have the effect of modifying the torque of the motor 1 so that the torque speed relationship will be substantially as indicated in the dotted line curve B in Fig. 2. As the cable tension increases and tends to overhaul the motor, in order to readjust the cable tension within the predetermined range, the motor torque will be sufficiently diminished to permit the motor to be pulled out of its zero torque speed and to permit the motor speed to be increased.

If the motor were designed to operate without the resistors 45, the speed value at zero torque at the point C might be made high enough, of course, to avoid the lock-in condition, but such speed would cause the motor to pay out too fast, and as a result the system would be subjected to excessive hunting action as the system would function to regulate the tension in the cable.

The motor will now operate in the pay-out direction of rotation. For normal operation, a portion of resistors 45 is shunted by contact members 49 of contactor switch 51. In order to obtain additional control of the motor torque during overhauling caused by excessive tension, the current responsive relay 53 is provided. The operating coil 57 of relay 53 is energized by the current passing through resistor 45 to the motor 1. If the operation is normal, that is, if the motor operates so that the rate of cable pay-out is sufficently great to relieve the excessive tension and the motor torque is such that the current through operating coil 57 remains below a predetermined magnitude, the relay 53 will not be actuated. However, when the motor speed is such that the excessive cable tension is not relieved, the motor torque, and therefore, the motor current, increases. When the current is above a predetermined magnitude, the relay 57 is actuated to open contacts 55, thus deenergizing operating coil 113 of contactor switch 51, and thereby causing contact members 49 to open. The resistance in the motor circuit is thus increased causing the motor speed to increase more rapidly as the motor torque increases. When the current decreases below the predetermined magnitude, the relay 53 is actuated to deenergize contactor 51, and thus the motor 1 again operates as indicated by curve B.

The motor 1 will continue to operate in the pay-out direction until the tension of the cable diminishes to the predetermined magnitude of tension at which the automatic tension controller 21 was operated. The tension controller 21 will thereupon be restored to its normal "Off" position and the contact segments 62, 63 and 64 will be disengaged from contact fingers 66, 67 and 68 to deenergize the various circuits and the operating coils connected thereto.

The circuit of the slow speed motor windings 33 will be opened by the opening of the contact members 39 and 43 of the "out" and "slow" contactors 27 and 31, and the motor 1 and drum 2 will be held in position by the restored brake 58, against displacement due to the tension of the mooring cable 5, if the effective length of cable or the total length of cable pay-out is below a predetermined magnitude. If the cable pay-out exceeds a predetermined length, the reclaiming controller 69 will be effective to initiate the reclaiming operation of the motor 1.

The reclaiming controller 69 is actuated by the drum 2 and it may be so arranged that the contact fingers 73, 74 and 77 are bridged by segment 71 and contact fingers 78 and 79 are bridged by segment 72 when the drum starts to rotate in the pay-out direction of rotation. If the tension remains above the predetermined magnitude, cable pay-out will continue. When the cable pay-out has exceeded the predetermined length, segment 71 also engages contact fingers 75 and 76 and segment 72 also engages contact finger 80. When the tension decreases to or below the predetermined magnitude, the segment 61 of tension controller 21 bridges contact fingers 65. Circuits are then completed to operating coils 115 and 117 of "fast" contactor 29 and "in" contactor 25, respectively, and to the coils of brake 59.

The circuit for operating coil 115 extends from energized conductor 103, contact fingers 95 and 97, bridged by segment 88 of manual controller 87, contact fingers 65 bridged by segment 61 of tension controller 21, contact fingers 73 and 76 bridged by segment 71 of reclaiming controller 69, operating coil 115, closed contacts 119, to energized conductor 107. The "fast" contactor switch 29 is thus actuated to close contact members 41.

The circuit for operating coil 117 extends from energized segment 71 bridging fingers 73 and 75, operating coil 117, closed contacts 121 to energized conductor 107. The "in" contactor 25 will thereupon be actuated to close contact members

37 to complete the circuit from the main supply source through conductors 23, contact members 37, contact members 41 to the high speed winding 35 of the motor 1.

The circuit for energizing the coil of brake 59 and thus releasing the brake, extends from energized conductor 103, contact members 95 and 96, bridged by segment 88, contact fingers 76 and 80 bridged by segment 72, the coil of brake 59 to energized conductor 107.

The motor will now operate at high speed in a direction of rotation to operate the winch drum 2 to heave-in the cable 5. As the heave-in or reclaiming operation continues, the reclaiming controller 69 is actuated in the direction to disengage segment 71 from contact fingers 75 and 76, and segment 72 from contact finger 80. However, the circuit for energizing the operating coil 115 is maintained through the holding circuit established through the contact members 85. Similarly, the circuits for energizing operating coil 117 and coil of brake 59 are maintained through contact members 81 and 83, respectively. The heave-in operation continues until segment 71 disengages from contact fingers 73, 74 and 77, and segment 72 disengages from contact fingers 78 and 79, thus deenergizing operating coils 115 and 117 and the coil of brake 59. The circuit of the high speed motor winding 35 will be opened by the opening of contact members 37 and 41 of the "in" and "fast" contactors 25 and 29, respectively, and the drum 2 will be held in position by the restored brake 59, against displacement due to the tension of the cable 5.

Should the cable tension increase above the predetermined magnitude during the heave-in operation, the tension controller 21 will be actuated to open the circuit through contact fingers 65 and segment 61 to deenergize the operating coils 115 and 117 to terminate the heave-in operation, as hereinabove described, and to establish circuit for effecting operation in the pay-out direction of rotation.

For manual control of the motor 1, the drum controller 87 is provided with an operating handle 123 to rotate the drum controller to either of two positions on the right side, and to either of two positions on the left side of its normal neutral "off" position for slow or fast operation in either direction. When the handle 123 is released, two balanced restoring springs 125 and 127 return the manual drum controller 87 to its neutral position.

When the manually operable controller is moved from its neutral position, segment 88 is disengaged from contact fingers 96, 97, 98 and 99 to open the various control circuits from the automatic tension controller 21 and reclaiming controller 69. The manual controller 87 will then assume control according to the direction in which it is moved, and according to the position to which it is moved in either of such directions.

When the motor 1 is to be operated to reel in cable, the manual controller 87 should be moved to the left. When the controller 87 is moved to the left, contact fingers 90, 92, 94 and 95 will be bridged by segments 89 and 88 at the first position to energize the operating coils 117 and 101 of "in" and "slow" contactor switches 25 and 31, respectively, and the brake release coil 59. The slow speed windings 33 of the motor 1 will be connected to the main circuit by contact members 37 and 43 through cross-conductors 47, and the brake 59 will be released from the motor 1.

If the controller 87 is then shifted further to the left, contact fingers 90, 94 and 95 will remain energized to keep the "in" contactor 25 closed and the brake 59 released. Contact finger 92 will be deenergized to open "slow" contactor 31 and contact finger 91 will be energized to close "fast" contactor 29. The "in" and "fast" contact members 37 and 41 will connect the high speed windings 35 of the motor 1 to the supply circuit 23, to operate the motor at high speed to heave in the cable.

When the motor is to be operated to pay out cable, the manual drum controller 87 will be moved towards the right. When the controller 87 is moved to the right, at the first position, contact fingers 92, 93, 94 and 95 will be energized to close "out" and "slow" contactor switches 27 and 31 to energize the slow speed windings 33, and to release the brake 59. The motor 1 will be operated in the reverse direction from the previous operation by reason of the reversed phase connections relative to the cross connecting conductors 47.

When the manual controller 87 is then moved further to the right, at second position, contact fingers 93, 94 and 95 will remain energized to hold contactor 27 closed and to hold the brake 59 open. Contact finger 92 will be deenergized to open the "slow" contactor 31, and contact finger 91 will be energized to energize the operating coil 115 of "fast" contactor 29. The high speed motor windings 35 will now be energized from the main circuit through the "out" contact members 39, contact member 49, a portion of the resistors 45, the cross-connecting conductors 47 and the "fast" contact members 41.

When the desired condition of the cable is attained, the manual controller handle 123 may be released, and it will resume its normal intermediate "off" position in response to the balanced forces of the restoring springs 125 and 127. The automatic control function will thereupon be restored to the automatic tension controller 21 and reclaiming controller 69 by the reclosure of the neutral segments 96, 97, 98 and 99 of the manual controller 87.

By the provision of two windings or a two speed winding in the motor 1, for slow and for fast operation, and the associated control equipment operating as described, a squirrel-cage motor may be utilized for winch service and safely employed in applications where sparks or arc might be generated by a commutator or slip ring to present a dangerous hazard.

My invention, therefore, contemplates the use of a squirrel cage motor provided with a multi-speed winding combination to control the operation of a winch, with the addition of torque modifying means to prevent the motor from establishing a lock-in condition that would prevent the motor from rotating above such lock-in speed when the cable tension became excessive and tended to overhaul the motor.

My invention is not limited to separate windings in the motor, since the same windings may be arranged to estabilsh different numbers of poles for high speed and low speed conditions. Similarly, the tension measuring and control equipment may be modified without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim as my invention:

1. A winch system comprising a squirrel cage motor provided with one set of stator windings for slow speed operation and a second set of stator windings for high speed operation, a source

of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, means responsive to the cable tension, said means including a controller movable to a high tension position in response to cable tension in excess of a predetermined value and movable to a low tension position in response to cable tension less than a predetermined value, a controller operable in response to the length of cable paid-out by said reeling drum, switching means controlled by the second mentioned controller when said cable tension responsive means is at its low tension position to connect the high speed windings of the motor to the source to operate the motor in a direction to heave in the cable, and further switching means controlled by the controller when said cable tension responsive means is at its high tension position to connect the slow speed windings of the motor to the source to operate by the motor in a direction to pay out the cable to diminish the cable tension.

2. A winch system comprising a squirrel cage motor provided with one set of stator windings for slow speed operation and a second set of stator windings for fast operation, a source of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, means responsive to the cable tension including controller means, said controller means being movable to a high cable tension position in response to cable tension in excess of a predetermined value and movable to a low cable tension position in response to cable tension less than a predetermined value, and means operated by said controller means, when the latter is moved to high tension position, to connect the motor windings to establish slow speed pay out rotation, and further controller means operable by said drum being effective, when the tension-responsive controller means is moved to low tension position, to connect the motor windings to establish high speed heave in operation.

3. In a winch system, the combination with a multi-speed squirrel cage induction motor, a reeling drum operated by the motor, a source of energy for the motor, a cable operated by the drum, means for selectively connecting the motor to the source to reel in or to pay out at predetermined speeds, resistance means connected to the motor circuit to modify the torque characteristic of the motor, under cable overhauling conditions, to prevent a substantial lock-in of the motor at synchronous speed, and means responsive to the motor current for controlling the said resistance means.

4. A winch system comprising a squirrel cage induction motor provided with a multi-speed winding, a source of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, tension control means responsive to the cable tension for connecting the motor to the said source for slow speed operation in the pay-out direction of rotation when the cable tension is above a predetermined magnitude, and reclaiming control means responsive to the effective length of the cable and electrically connected to the tension control means for connecting the motor to the said source for high speed operation in the heave-in direction of rotation when the cable tension is at or below a predetermined magnitude.

5. A winch system comprising a squirrel-cage induction motor provided with a multi-speed winding, a source of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, tension control means responsive to the cable tension for connecting the motor to the said source for operation at a predetermined speed in the pay-out direction of rotation when the cable tension is above a predetermined magnitude, and reclaiming control means responsive to the effective length of the cable and electrically connected to the tension control means for connecting the motor to the said source for operation at a predetermined speed in the heave-in direction of rotation when the cable tension is at or below a predetermined magnitude.

6. A winch system comprising a squirrel-cage induction motor provided with a multi-speed winding, a source of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, tension control means responsive to the cable tension for connecting the motor to the said source for operation at a predetermined speed in the pay-out direction of rotation when the cable tension is above a predetermined magnitude, control means responsive to the motor current for adjusting the speed torque characteristic of the motor in the pay-out direction of rotation in response to a predetermined change in the motor current, and reclaiming control means responsive to the effective length of the cable and electrically connected to the tension control means for connecting the motor to the said source for operation at a predetermined speed in the heave-in direction of rotation when the cable tension is at or below a predetermined magnitude.

7. A winch system comprising a squirrel-cage motor provided with one set of stator windings for operation at a first speed in one direction and a second set of stator windings for operation at a second speed in another direction, a source of energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, braking means effective to prevent rotation of the drum when said motor is disconnected from said source, means responsive to the cable tension, means responsive to the effective length of the cable, switching means controlled by said means responsive to cable tension for connecting said stator winding to said source for operation at said first speed when the cable tension is above a predetermined magnitude, and switching means controlled by said means responsive to the cable length for connecting said stator winding to said source for operation at said second speed when the effective length exceeds a predetermined magnitude, said first switching means, responsive to cable tension when the tension is below a predetermined magnitude adapted to control the operation of the second named switching means.

8. A winch system comprising a squirrel cage motor provided with one set of stator windings for slow speed operation and a second set of stator windings for high speed operation, a source of alternating current energy for the motor, a reeling drum operated by the motor, a cable operated by the drum, means responsive to the cable tension, a controller operated by the said means responsive to cable tension, said controller being movable to a high tension position when the cable is subjected to a given high tension and being movable to a low tension position when the cable is subjected to a given low tensions, means responsive to the cable length paid-out by said reeling drum, a second controller operated by the means responsive to the cable

length paid-out by the reeling drum, and switching means selectively controlled by said controllers for connecting the windings of the motor to the source of alternating current energy either to operate the motor at slow speed in response to the tension in the cable or at high speed in response to the length of the cable paid-out by the reeling drum.

9. A winch system comprising a squirrel cage motor provided with one set of stator windings for slow sped operation and a second set of stator windings for high speed operation, a source of alternating current energy for the motor, a reeling drum connected to be operated by the motor, a cable wound on the drum to be thus either paid-out or heaved-in by the drum depending on the operation of the drum, means responsive to the cable tension, a controller operated by the means responsive to the cable tension, said controller being movable to a high tension position when the cable is subjected to a given high tension and being movable to a low tension position when the cable is subjected to a given low tension, means responsive to the cable length paid-out by said reeling drum, a second controller operated by the means responsive to the cable length paid-out by the reeling drum, first switching means for connecting the slow speed windings of the motor to the said source of alternating current to operate the reeling drum to permit paying out cable, and second switching means for connecting the high speed windings of the motor to the said source of alternating current to operate the reeling drum to heave-in cable when the cable length paid-out is above a certain length, said controllers being interconnected to control said two switching means to pay-out cable at a slow speed or to heave-in cable at a high speed when the tension is at the low value and paid-out cable length is above a certain value.

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