

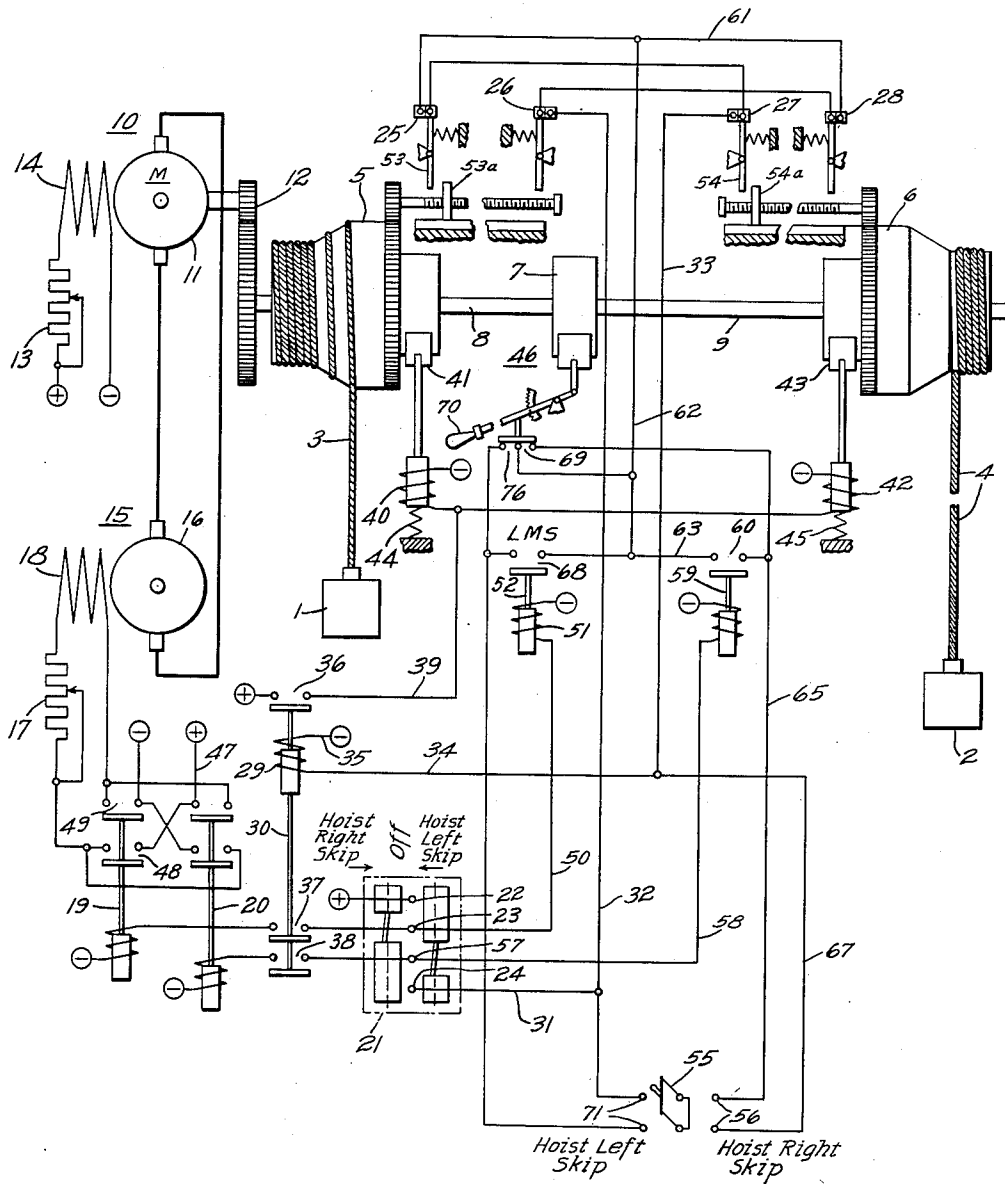
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HOIST CONTROL

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HOIST CONTROL

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My invention relates to a control system which is particularly useful in mine hoists and the like.

In the control for motors operating mine hoists, and the like, it is common practice to provide limit switches for protection against overwind, or overtravel of a skip or cage, either at the top of the shaft (in the head frame) or at the bottom of the shaft. It is also common practice to provide, in the control, a device, ordinarily known as a back-out switch, to permit the operator to short-circuit the overtravel limit switch (or switches) that have been opened, and at the same time disconnect the control circuits to one set of reversing contactors, so that power can be applied to the hoist only in a direction to back out of the overwind.

Such protective devices as have been employed in the past do not give full protection, for, with a balanced hoist (employing two interconnected skips or cages in separate shaft compartments) after an overwind, if the operator should move the back-out switch in a direction to short-circuit the limit switch that has opened, and then release the brakes, it is possible for the skip or cage in the head frame to be moved farther in the direction of overwind, under the overhauling load of the rope and skip (or cage) in the other shaft compartment. Also, to obtain power for backing out of the overwind, it is necessary for the operator to move the master switch in the proper direction. If he moves the master switch in a direction that would normally apply power in a direction to continue the overwind, the circuit to the reversing contactors would be broken on the master switch, so that power would not be applied. This, of course, would give the same results as would be obtained by releasing the brake without moving the master switch, and under the overhauling load, the skip or cage may be pulled farther in the overwind direction, with consequent damage, unless the operator acts quickly enough to reapply the brake.

An object of my invention is to provide a control scheme which will make it impossible, after overtravel of the skips, to release the brakes if power is applied in the wrong direction, that is, in a direction to cause farther overtravel (or overwind).

Another object of my invention is to provide a control scheme which, after overtravel of the skips, will prevent additional overtravel normally effected by an overhauling load.

Other objects and advantages will become more apparent from a study of the following specification when considered in conjunction with the ac-

companying drawing, in which the single figure is a schematic showing of a control system embodying the principles of my invention.

Referring more particularly to the single figure, numerals 1 and 2 denote skips or cages which are suspended by cables 3 and 4, wound on drums 5 and 6, respectively. The two drums 5 and 6 are mechanically coupled by a brake drum 7 through shafts 8 and 9 or through suitable clutches (not shown) if desired. A driving motor 10 has an armature 11 which is mechanically coupled through gears 12 to drums 5 and 6 (assuming the clutches, if utilized, are engaged). The speed of motor 10 may be varied by varying resistor 13 which will change the value of current through field winding 14. Energy is supplied to motor 10 by generator 15 which has an armature 16 connected across the terminals of motor armature 11. Variable resistors 17 change the value of current through field winding 18, thereby securing different values of generating current. Reversing contactors 19 and 20 are provided in order to secure reversal of current flow through field winding 18, thereby securing reversal of motor 10.

The operation of the control system is as follows:

Assume that the control system is in a de-energized condition as shown in the drawing and assume that it is desired to hoist the left skip 1. The operator will thus move controller 21 to the left and by means of its contact segments will bridge contact members 22, 23 and 24—contact member 22 being considered also as a positive terminal of a direct current source of potential. A circuit will now be completed through all the limit switches 25, 26, 27 and 28 and through actuating coil 29 of relay 30 which may be traced from the (+) terminal 22 through the controller segment and contact member 24, through conductors 31, 32, limit switches 26, 28, 25 and 27, (in the order named) conductors 33 and 34, actuating coil 29 to the negative terminal 35 of the direct current source. Energization of coil 29 will cause relay 30 to close contact members 36, 37 and 38. Closing of contact members 36 will complete a circuit from the terminal marked (+) immediately adjacent thereto, through contact members 36, conductor 39, thence through two parallel circuits, one going through brake coil 40 of the auxiliary or emergency brake 41 to a negative (—) terminal and the other going through brake coil 42 of the emergency brake 43 to a negative (—) terminal. Energization of both brake coils 40 and 42 will counteract the force of the asso-

ciated brake-applying springs 44 and 45, respectively, and release the brakes. In order to fully release the drums a mechanically operated brake 46 must also be released.

Since, as described above, contact members 37 are closed, another circuit will be completed from the (+) terminal 22, through contact members 22, 23 and 37, the actuating coil of reversing contactor 19 to the (-) terminal, thus actuating contactor 19 and completing a circuit from (+) terminal 47, through contact members 43, resistor 17, generator field winding 18, contact members 49 to the terminal marked (-). Now since the generator field winding 18 is energized, motor 10 will be driven in a direction so as to raise the left skip 1. Still another circuit will be completed which may be traced from (+) terminal 22 through the controller segment and contact members 23, through conductor 50, the actuating coil 51 of relay 52 to the (-) terminal. Actuation of relay 52 will at this stage have no effect on the system however.

Assume now that the left skip, either through neglect of the operator or for any other reason, has been hoisted too far, thus effecting opening of limit switches 25 and 27 by virtue of the screw propelled, switch operating members 53-53a and 54-54a forming a carriage as is well known in the art. Opening of limit switches 25 and 27 will, of course, interrupt the first mentioned circuit through all the limit switches and actuating coil 29 thereby effecting deenergization of relay 30 and opening of contact members 36, 37 and 38. Opening of contact members 36 will deenergize brake coils 40 and 42 and effect application of the brakes by springs 44 and 45 (or any other suitable means such as hydraulic means or compressed air). Opening of contact members 37 will effect deenergization of relay 52 and of contactor 19, the latter effecting deenergization of the generator field winding 18 thus stopping motor 10.

In order to restore skips 1 and 2 in a non-overwound or non-overtravelled position, a backout switch 55 is thrown to the right thus bridging contact members 56. Mechanical brake 46, if previously applied, is now released. Now controller 21 is moved to the right in order to raise the right skip 2 and lower the left skip 1 so as to remove them from their overwound position. A circuit will now be completed extending from (+) terminal 22, through the left controller segment, contact members 57, conductor 58, the coil of relay 59 to the (-) terminal thereby effecting closing of contact members 60.

Another circuit will now be completed through limit switches 26 and 28 and actuating coil 29 which may be traced from the (+) terminal 22 through the left controller segment, contact member 24, conductors 31 and 32, limit switches 26 and 28, conductors 61, 62 and 63, contact members 60, conductor 65, contact members 56, conductors 67 and 34, coil 29 to the (-) terminal 35. Energization of coil 29 will actuate relay 30 so as to close contact members 36, 37 and 38 so as to restart the motor. However, reversing contactor 20, instead of reversing contactor 19 will be energized (due to the movement of controller 21 to the right) thereby reversing the current through generator field coil 18 thereby effecting reversal of motor 10 and effecting a drive in an opposite direction to that previously described above so as to cause raising of the right skip 2 and lowering of the left skip so as to

withdraw the skips from their overtravelled position.

Let us assume instead that the operator, after having thrown the backout switch 55 to the right, that, by mistake, he moves controller 21 to the left instead of the right thereby tending to raise the left skip and lower the right skip thereby causing further overtravel or further movement into the overwind. In doing so, relay 52 instead of relay 59 will become energized consequently contact members 63 will close but contact members 60 will open. Opening of contact members 60 will interrupt the last described circuit extending through limit switches 26 and 28 and coil 29. It is true that while mechanical brake 46 is applied a temporary shunt path will be formed across contact member 60 by virtue of the closed brake contact members 69 operated thereby, however, this path will become immediately opened as soon as the lever 70 is operated so as to release the mechanical brake 46.

In other words, the limit switches are nullified by virtue of a shunt path only if contact members 60 and contact members 68 are both closed since both of these contact members are in series in the shunt path, hence both must be closed to complete it. However, if either contact members 60 (due to wrong movement of controller 20) or contact members 68 are open (due to wrong movement of the backout switch 55), then no shunt path will be formed to effect bridging of limit switches 25 and 27 hence the brakes cannot be released.

Similarly as described above, if the left skip should descend too low and the right skip, too high, limit switches 26 and 28 would open thereby stopping the drive. Thereafter, in order to move the skips out of the overwind, it will be necessary to throw backout switch 55 to the left to close contact members 71, and to move controller 21 to the left so as to effect closing of contact members 68. Contact members 71 and 68 are series connected and when they are both closed form a shunting path across limit switches 26 and 28 so as to permit operation of motor 10 so as to remove skip from their overwound positions. Brake contact members 75 form a shunt path across contact members 68 only when the mechanical brake is applied and not when it is released.

Although two limit switches 25 and 27 operate as the result of excessive hoisting of left skip 1 and excessive lowering of right skip 2, it will be readily apparent that a single limit switch could be used instead to denote both of these conditions. Likewise a single limit switch could be used instead of limit switches 26 and 28 to denote excessive lowering of the left skip as well as excessive hoisting of the right skip. By using two limit switches as shown in the drawing instead of one there may be a time delay between the operation of one and the operation of the other thus permitting a more flexible scheme.

I am, of course, aware that others, particularly after having had the benefit of the teachings of my invention, may devise other devices embodying my invention, and I, therefore, do not wish to be limited to the specific showings made in the drawing and the descriptive disclosure hereinbefore made, but wish to be limited only by the scope of the appended claims and such prior art that may be pertinent.

I claim as my invention:

1. A control system including a reciprocable element, a motor for reciprocating said element

within a predetermined path, a brake limit switch means which is operable when said element overtravels said predetermined path to apply said brake, back-out switch means for rendering ineffective said first-mentioned means connected in shunt relationship with said limit switch means, for releasing said brake, and for allowing application of power from said motor to said element for returning said element from its overtravelled position to a position in said predetermined path, and means dependent upon the occurrence of overtravel of said reciprocable element and the direction of power flow to said motor for making said releasing of said brake impossible in the event of application of motor power to said element which would tend to cause further overtravel instead of return to said predetermined path.

2. A control system including a reciprocable element, a motor for reciprocating said element within a predetermined path, a brake, limit switch means which is operable when said element overtravels said predetermined path to apply said brake, back-out switch means connected in shunt relationship with said limit switch means for rendering ineffective said limit switch means for releasing said brake, and for allowing application of power from said motor to said element for returning said element from its overtravelled position to a position in said predetermined path, and means dependent upon the occurrence of overtravel of said reciprocable element and the direction of power flow to said motor for making said releasing of said brake impossible in the event of application of motor power to said element which would tend to cause further overtravel instead of return to said predetermined path.

3. A control system including a reciprocable element, a motor for reciprocating said element within a predetermined path, a brake, limit switch means which is operable when said element overtravels said predetermined path to apply said brake, back-out switch means connected in shunt relationship with respect to said limit switch means for rendering ineffective said limit switch means connected in shunt relationship with said limit switch means, for releasing said brake, and for allowing application of power from said motor to said element for returning said element from its overtravelled position to a position in said predetermined path, and means dependent upon the occurrence of overtravel of said reciprocable element and the direction of power flow to said motor for making said releasing of said brake impossible in the event of application of motor power to said element which would tend to cause further overtravel instead of return to said predetermined path.

4. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a brake limit switch means associated with each skip which is operable when the skip goes too high or too low with respect to a predetermined normal path, back-out switch means for rendering ineffective said limit switch means connected in shunt relationship with said limit switch means, for releasing said brake, and for allowing application of power from said motor to said skips for returning said skips from their overtravelled position to a position in said predetermined path, and means dependent upon

the occurrence of overtravel of said reciprocable cages and the direction of power flow to said motor for making said releasing of said brake impossible in the event of application of motor power to said skips which would tend to cause further overtravel instead of return to said predetermined path.

5. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a pair of limit switch means, one of which is openable to apply said brake when a particular skip goes too high, and the other of which is also openable to apply said brake when the same skip goes too low with respect to a predetermined normal path of movement, a pair of manually operable back-out switch means each of which is connected in shunt relationship with one of said limit switch means for rendering ineffective one of said limit switch means after it has operated because of overtravel of the skips, to allow release of said brake and application of motor power to said skips for their return to said predetermined normal path, a master controller for effecting reversing operation of said motor, a pair of auxiliary contactors which are respectively operable by opposite movements of said master controller, one to effect hoisting of one skip and lowering of the other and the other to effect opposite movement of both skips, circuit means interconnecting said back-out switches, auxiliary contactors and limit switch means and dependent jointly upon the direction of overtravel of the skips and the direction of movement of the master controller to prevent release of said brake in the event said master controller is moved in the wrong direction after overtravel, that is in a direction to cause further overtravel instead of return to said predetermined normal path.

6. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a pair of limit switch means, one of which is operable to apply said brake when a particular skip goes too high, and the other of which is also operable to apply said brake when the same skip goes too low with respect to a predetermined normal path of movement, a pair of back-out switch means each of which is for rendering ineffective one of said limit switch means connected in shunt relationship with one of said limit switch means, to allow release of said brake and application of motor power to said skips for their return to said predetermined normal path, a master controller for effecting reversing operation of said motor, a pair of auxiliary contactors which are respectively operable by opposite movements of said master controller, one to effect hoisting of one skip and lowering of the other and the other to effect opposite movement of both skips, said back-out switches and said auxiliary contactors being connected in series relationship, each back-out switch together with one of said auxiliary contactors forming a shunt path across one of said limit switch means so as to prevent release of said brake in the event said master controller is moved in the wrong direction after overtravel, that is in a direction to cause further overtravel instead of return to said predetermined normal path.

7. A control system including a pair of skips

or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a pair of limit switch means, one of which is operable to apply said brake when a particular skip goes too high, and the other of which is also operable to apply said brake when the same skip goes too low with respect to a predetermined normal path of movement, a pair of back-out switch means each of which is for rendering ineffective one of said limit switch means connected in shunt relationship with one of said limit switch means, to allow release of said brake and application of motor power to said skips for their return to said predetermined normal path, a master controller for effecting reversing operation of said motor, a pair of auxiliary contactors which are respectively operable by opposite movements of said master controller, one to effect hoisting of one skip and lowering of the other and the other to effect opposite movement of both skips, said back-out switches and said auxiliary contactors being connected in series relationship, each back-out switch together with one of said auxiliary contactors forming a shunt path across one of said limit switch means, a pair of brake contactors operated by a supplementary mechanical brake also connected in series with said back-out switches, and with a brake actuating coil, each of said brake contactors being connected in shunt relationship with one of said auxiliary contactors, a master controller for effecting control of said reversible motor and movement of which, on either side of a neutral position, is effective to close one of said auxiliary contactors thereby allowing release of said brake only on condition that said master controller is moved in the proper direction to close the proper auxiliary contactor, after overtravel of skips, for restoring them to said predetermined normal path.

8. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a brake limit switch means associated with each skip which is operable when the skip goes too high or too low with respect to a predetermined normal path, a pair of back-out switches, a pair of brake contactors and a brake actuating coil all connected in series circuit relationship, a pair of limit switches, each of which bridges one back-out switch and one serially connected aforementioned brake contactor, means dependent upon the direction of overtravel of the skips and the direction of energy application to said reversible motor for opening said brake contactors and for making it impossible to energize said brake actuating coil to re-

lease the brake in the event said application of motivating energy is applied in the wrong direction to effect back-out of said skips, following overtravel thereof.

9. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a brake limit switch means associated with each skip which is operable when the skip goes too high or too low with respect to a predetermined normal path, a manually operable double-throw switch device including a pair of back-out switches, a pair of brake contactors and a brake actuating coil all connected in series circuit relationship, a pair of limit switches, each of which bridges one back-out switch and one serially connected brake contactor, mechanical brake releasing means for opening said brake contactors, and an auxiliary contactor in shunt relationship with each of said brake contactors and which are selectively energized depending upon the direction of drive imposed on said skips by said motor and which are effective either to allow or not to allow release of said brakes depending upon whether or not the proper direction of drive has been imposed on said skips, following overtravel thereof, to return them to said predetermined normal path.

10. A control system including a pair of skips or cages connected for balanced operation, that is, which are simultaneously reciprocable in opposite directions, a reversible motor for so reciprocating said skips, a brake limit switch means associated with each skip which is operable when the skip goes too high or too low with respect to a predetermined normal path, a pair of back-out switches, a pair of brake contactors and a brake actuating coil all connected in series circuit relationship, a pair of limit switches, each of which bridges one back-out switch and one serially connected brake contactor, means for opening said brake contactors, and an auxiliary contactor in shunt relationship with each of said brake contactors, a master controller controlling the direction of rotation of said motor, said auxiliary contactors being openable by said master controller so that movement of said master controller for effecting either forward or reverse drive will close only one of said auxiliary contactors, thereby effecting release of said brake provided that the master controller is moved in the proper direction, following overtravel of the skips, to return the skips to said predetermined normal path, and to prevent release thereof in the event of movement of the controller in a direction which would tend to cause further overtravel.

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