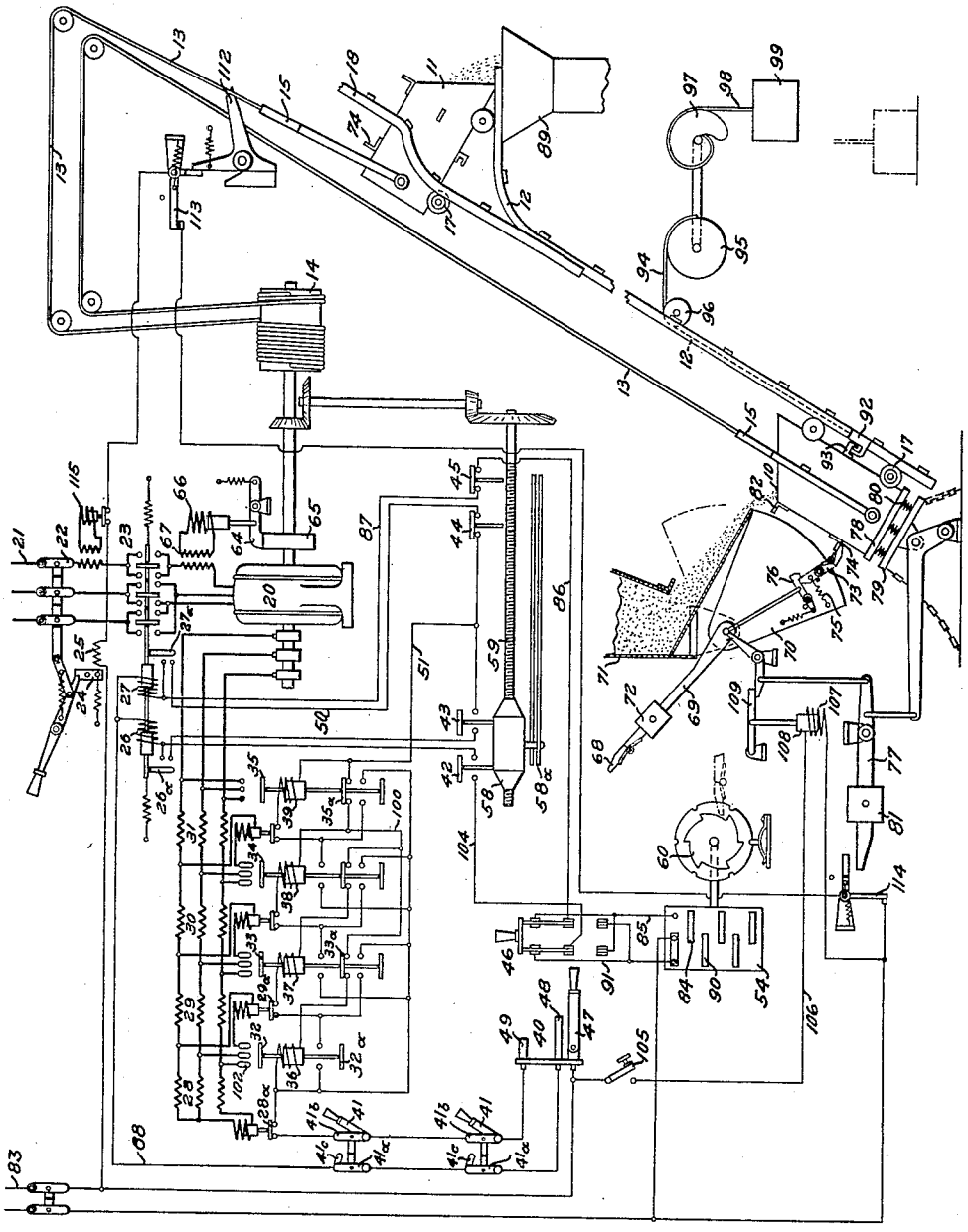
R. C. NEWHOUSE.

SYSTEM OF CONTROL.

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SYSTEM OF CONTROL.

1,279,748. Specification of Letters Patent. Patented Sept. 24, 1918.

Original application filed May 9, 1912, Serial No. 696,107. Divided and this application filed January 2, 1917. Serial No. 140,640.

To all whom it may concern:

Be it known that I, RAY C. NEWHOUSE, a citizen of the United States of America, residing at Wauwatosa, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Systems of Control, of which the following is a specification.

My invention relates to electrically operated skip hoists.

It is the object of my invention to provide a skip hoist, for hoisting stone, coal, ore, etc., which is normally completely automatic in its operation but may be manually controlled when desired.

In attaining this object, I have provided a system involving a number of novel features. The movement of the skips is preferably obtained by an electric motor, and the motor is controlled by the closing of the gate of the bin from which the material to be hoisted is supplied to the skip at the bottom of the hoist. The automatic operation of the motor is always in the proper direction to raise the loaded skip and lower the empty skip, the motor being reversible for this purpose. The closing of the bin gate occurs when the load in the skip at the bottom of the hoist reaches a predetermined value. The closing of the bin gate is also manually controlled irrespective of the load in the skip. Although the operation is normally entirely automatic, the operator may at any time assume control and obtain any desired movement of the skips within their limits of movement. There are also provided a number of safety devices.

The broad features of my invention are claimed in my copending application, Ser. No. 696,107, filed May 9, 1912, (Patent 1,219,761, Mar. 20, 1917,) of which the present application is a division, and in my copending application, Ser. No. 633,798, filed June 17, 1911 (Patent 1,207,983, Dec. 12, 1916). Further, certain features of the electrical operation and control of the hoist system of this application are introduced in my copending application, Ser. No. 123,788, filed Oct. 2, 1916, which is a division of my application, Ser. No. 633,798, filed June 17, 1911.

The various novel features of my invention will appear from the description and drawings, and will be particularly pointed out in the claims.

The single figure of the drawing shows diagrammatically one embodiment of my invention.

The two skips 10 and 11 operate on the usual tracks 12, these tracks 12 being arranged so that the skips pass each other without interfering and yet each skip when at the bottom of the hoist occupies substantially the same place as does the other skip under the same circumstances. The operating cable or cables 13 extend in the usual manner around the winding drum 14, and its ends are fastened to bails 15 pivoted to the skips near their rear ends. This manner of pivoting the bails 15 allows the automatic tipping of the skips as they reach the top. To obtain this tipping, the rear axle of each skip is provided with additional wheels 17, which engage the auxiliary track 18 when the skip is at the top of the hoist. As a skip approaches the top, its front axle follows the curved upper end of the main track 12, while its rear axle follows the auxiliary track 18, the skip being thus automatically dumped; the skip 11 is shown dumping.

The hoisting drum 14 is operated by the motor 20, preferably being directly connected thereto. This motor may be of any desired type, being shown as an induction motor of the wound rotor type. Its primary circuit is supplied from a three-phase line 21, through a circuit-breaker 22 and a reversing switch 23. The circuit-breaker 22 is biased to open position, but is held in closed position by a latch 24. The latch in turn is biased to unlatching position, but is held in latching position by a solenoid 25 located in a circuit which, under normal conditions, is always closed. The circuit of this solenoid may be called an emergency control circuit. Upon the deënergization of the solenoid 25, for any reason, the circuit-breaker 22 opens. The reversing switch 23 is preferably of the oil immersed, double-throw, multiple type, and is biased to open position. It is movable to its two closed positions by solenoids 26 and 27 respectively. In the rotor circuit of the motor 20 are resistance sections 28, 29, 30, and 31, which may be short-circuited by switches 32,

33, 34, 35, operated by solenoids 36, 37, 38, and 39 respectively. The solenoids 26, 27, 36, 37, 38, and 39 are controlled by a manually operated master switch 40, a plurality of manually operated switches 41, a set of switches 42 to 45 inclusive, automatically actuated master direction switch 54, and a manually controlled reversing switch 46.

The master switch 40 is provided for manually starting and stopping the motor and skips. In closing the switch, the blade 47 first engages contact 48 for energizing solenoids 26 and 27 for operating the switch 23 in one direction or the other. Upon further movement of the blade 47 in the same direction, said blade comes into engagement with contact 49 for energizing solenoids 36, 37, 38, and 39 of the resistance switches 32, 33, 34, and 35 respectively. By opening the master switch 40, the blade leaves contacts 49 and 48 successively. On leaving the contact 49 it deënergizes all the resistance controlling solenoids 36 to 39 inclusive. By leaving contact 48, somewhat later, it deënergizes the solenoids of the switch 23, thus causing the breaking of the primary circuit of the motor. This avoids the jar which would be given the motor if the primary circuit were broken before the resistance in the rotor circuit were cut in. This master switch is to be located at some convenient point, such as at the main operating stand.

The manually operated switches 41 are located at various points in the control system. For instance, these switches may be located on different floors or at points of comparatively great distance from each other. These switches 41 are adapted, when switch 40 is closed, to start and stop the operation of the whole system in the same manner as it is accomplished by the operation of the master switch 40. The switches are here used primarily as emergency switches for shutting down the system from various points if it is desired so to do for any particular reason. The switches 41 each have two movable contacts 41^a and 41^b, the first of which engages an elongated contact 41^c so that when said switches are opened the sections of resistance controlled by the contact 41^b will be cut into circuit before the main line circuit is opened by separating contacts 41^a and 41^c. It is to be noted, however, that only one such switch as 40 is to be used, while any number of switches 41 can be employed. The reason for this is apparent, for if two such switches as 40 were used, one could be opened and still the system would continue to operate, providing the one remaining closed was on the live side of the open switch.

The switches 42 to 45 inclusive are biased to their lower positions, as by gravity, but may be raised to their upper positions by a taper-ended nut 58 traveling along a threaded rod 59 driven through suitable reducing gearing from the shaft of the motor 20. Guides 58^a prevent the nut 58 from turning. These switches are closed only in their lower positions. The switches 42 and 45 in their lower positions are in the circuits of the solenoids 26 and 27 respectively. The switches 42 and 43 are in circuit with the solenoids 36 to 39 inclusive when the motor is operating in one direction, and the switches 44 and 45 are in circuit with said solenoids when the motor is going in the opposite direction. The switches 42 to 45 inclusive may be spaced as desired.

The master direction switch 54 has on its shaft a ratchet wheel 60, the number of teeth of the ratchet wheel corresponding to the number of positions of the switch 54. This number is an even number, the switch in alternate positions closing the circuit of the switches 42 and 43, and 44 and 45, respectively; thus oppositely controlling the direction of operation of the motor 20. The switch 54 is operated automatically, through the ratchet wheel 60, in a manner hereinafter described.

My present system is also provided with the double-throw switch 46 for the purpose of manually reversing the direction of operation at any time without regard to the direction in which the system is operating or to the position of the skips. In other words, switch 46 when thrown to the position opposite to the one in which it is found changes the connections of switch 54 and switches 42 to 45 inclusive for controlling the actions of solenoids 26 and 27 for reversing the motor 20. When switch 23 is operated, auxiliary switches 26^a and 27^a are also operated for controlling the circuits of solenoids 36 to 39 inclusive of the resistance switches 32 to 35 inclusive. Thus the operation of the system may be manually reversed at will by merely throwing switch 46 to the position opposite to the one in which it is found.

The motor is provided with a mechanical brake 64, coöperating with a disk 65 on the shaft of the motor 20. The brake is released by a solenoid 66 whenever current is being supplied to the motor 20, the solenoid 66 being connected to the motor circuit through a current transformer 67.

The automatic operation of the ratchet wheel 60 above referred to is obtained by a finger 68 hinged on the balance arm 69 of the gate 70 of the supply bin 71. The bin gate 70 is biased to closed position by an adjustable weight 72 on the balance arm 69. During the last part of the closing movement of the bin gate 70 the finger 68 strikes one of the teeth of the ratchet wheel 60 and moves the master direction switch 54 from one position to the next. The bin gate 70 carries a pivoted finger 73, which is in the

path of an arm 74 on the top of each skip. The finger 73 is biased into the path of the arm 74 by a light spring 75 and most of the time is held there by a latch 76, which latter is connected by suitable connecting mechanism to the balance beam 77 of a scale upon which the skip at the bottom of the hoist rests and is released upon a sufficient deflection of said beam. The platform of this scale consists of two parallel plates 78 and 79, the former being mounted on the other by a nest of springs 80. On the balance beam 77 is an adjustable weight 81 for determining the load taken by the skip.

Assume that the parts are in the positions shown, the arm 74 on the skip 10 having engaged the finger 73 and opened the bin gate 70 as such skip approached the bottom of the hoist. Immediately upon the opening of the bin gate, the stone, ore, or other material to be hoisted, begins to run from the bin 71 into the skip 10, which may be provided with a lip 82 to prevent any of the material from falling between the gate and the skip. The circuit-breaker 22 is closed. The switch 23 is in its middle or off position, the traveling nut is at the extreme left hand limit of its movement, holding switches 42 and 43 in their upper or open positions. The switches 45 and 46 are in their lower or closed positions. The resistance switches 32 to 35 inclusive are in the lower or open positions.

To make the system operate automatically at full speed the master switch 40, switches 41 and 46 should be closed, and there left while the uninterrupted automatic operation is to continue. As the skip 10 fills, the plate 78 of the scale platform is depressed, first compressing the springs 80 and then engaging and depressing the plate 79 of the scale platform and raising the weight 81. When the load in the skip 10 reaches a predetermined value, the tilting of the balance beam 77 releases the latch 76, and the finger 73 momentarily swings past the arm 74 to allow the weight 72 to close the bin gate 70. This shuts off the supply of material to the skip 10. As the bin gate approaches its closed position, the finger 68 strikes one of the teeth of the ratchet wheel 60 and moves the master direction switch 54 forward to the next position beyond that which it occupies. This completes a control circuit which extends from one side of the control supply line 83 through contact 84 on the switch 54, conductor 85, reversing switch 46, conductor 86, switch 45, conductor 87, solenoid 27, conductor 88, switches 41 and 40, to the other side of the line 83. The resultant energization of coil 27 closes the switch 23 to the left, and also causes the closing of the auxiliary switch 27^a carried by the switch 23, thus putting the resistance switches 32 to 35 inclusive under the control of the switch 44 and completing the primary circuit of the motor 20 for operation in one direction. The completion of this primary circuit energizes solenoid 66 to release brake 64.

The motor 20 now starts slowly, driving the winding drum 14 and the rod 59, thus causing the skip 10 to start upward, the skip 11 to start downward, and the traveling nut 58 to start to the right. The hinged end of the finger 73, which finger has been brought back by the spring 75 into the path of the arm 74 and is reëngaged by the latch 76 as soon as the skip 10 has started upward, allows such arm to pass without effect as the skip 10 rises. As the nut 58 moves to the right, it first allows the switch 42 to drop from its upper to its lower position, thus making a potential circuit for solenoid 26, which at this time is open at the switch 54. As the nut 58 continues its movement to the right, it allows the switch 43 to drop to its lower or closed position, thus making another potential circuit, through the switch 43, for the solenoids 36 to 39 inclusive; this potential circuit is open at the switch 54 and at the auxiliary switch 26^a also carried by switch 23. The dropping of the switches 42 and 43 does not affect the speed of the motor 20. As soon as the switches 23 and 27^a are closed to the left a circuit is completed from one side of the control supply line 83 through contact 84 of switch 54, conductor 85, reversing switch 46, conductor 86, switch 45, conductor 87, branching from the circuit of solenoid 27 and continuing through auxiliary switch 27^a, conductor 50, switch 44, conductor 51, contact 35^a, conductor 100, switch 33^a, solenoid 36, auxiliary solenoid operated switch 28^a, conductor 101, switches 41 and 40 to the other side of the line 83. The resultant energization of operating solenoid 36 closes switch 32, thus cutting out the first section 28, of the resistance in the rotor circuit of the motor 20. If, however, the auxiliary switch 28^a has been opened, due to excess current in the secondary circuit when the motor is first started, switch 32 will not be closed until the current in the secondary circuit has decreased sufficiently to permit said switch 28^a to close. If, when switch 32 is closed, the secondary current rises above a predetermined value, auxiliary switch 29^a will be opened, thereby preventing solenoid 37 from being energized. At this point it is to be noted that the contacts 102 with which the resistance switch members 32, 33, and 34 come into contact are elongated. This is for the purpose of completing the circuit of the solenoid of the next auxiliary switch, such as 29^a, permitting said switch to be opened if the secondary current is above a certain predetermined value, before the switch 32^a is closed to complete the circuit of the solenoid 37 of the next resistance switch, such as 33. When switches 32

and 32ª are closed and 29ª has remained closed or returned to closed position, the circuit of the solenoid 37 is completed, resulting in the closing of switch 33 and the cutting out of the second section, 29, of the resistance. Similarly switches 34 and 35 are closed in turn, successively cutting out the remaining sections 30 and 31 of resistance. This brings the motor 20 up to full speed.

Such full speed continues until the skip 10 approaches its upper limit of movement and the skip 11 its lower limit of movement. At the same time, the traveling nut 58 approaches its right hand limit of movement. The tapered end of nut 58 now raises switches 44 and 45 successively. The lifting of the switch 44 breaks the circuit for the solenoids 36 to 39 inclusive, thus deenergizing all solenoids which remained energized and causing the cutting of all the resistance sections 28 to 31 inclusive into the rotor circuit of the motor 20 to check the speed thereof. The lifting of switch 45 deenergizes solenoid 27, thus causing the opening of auxiliary switch 27ª and causing switch 23 to move to its middle or off position and interrupting the supply of current to motor 20. The interruption of this supply of current causes the deënergization of the solenoid 66, and the setting of the brake 64.

The motor 20 and the two skips now stop, the skips 10 and 11 having now reached their upper and lower limits respectively. The skip 10 in approaching this upper limit has tipped to dumping position, the wheels on its front axle having followed the curve at the upper end of the main track 12 and the auxiliary wheels on its rear axle having followed the auxiliary track 18. The material is thus dumped from the skip into the receiving bin 89. The arm 74 of the skip 11, as the latter has approached its lower limit of movement, has engaged the finger 73 and swung the bin gate 70 to open position, whereupon the supply bin 71, unless empty, immediately begins to discharge material into the skip 11. When the skip 11 is filled with a predetermined load, the finger 73 is again released from the latch 76 and the bin gate 70 again swings closed. At the end of this closing movement, the finger 68 engages the next tooth of the ratchet wheel 60, and swings it and the master direction switch 54 forward to the next position. This brings the contact 90 of said switch into operation, and completes a circuit which extends from one side of the line 83 through contact 90 of switch 54, conductor 91, reversing switch 46, conductor 104, switch 42, solenoid 26, conductor 88, switches 41 and 40 to the other side of the line 83. The resultant energization of the solenoid 26 causes switch 23 and auxiliary switch 26ª to close to the right, thus putting the solenoids 36 to 39 inclusive under the control of the switch 43, completing the primary circuit of motor 20 for operation in the opposite direction from that above described, and releasing the brake 64.

The motor 20 now starts in such opposite direction, raising skip 11, lowering the skip 10, and moving the traveling nut 58 to the left. As this movement of the nut 58 continues, switches 45 and 44 are dropped in succession and the resistance sections 28, 29, 30, and 31 are cut out in a manner substantially the same as that already described. The action of the switches 45 and 44 corresponds to the previous action of switches 42 and 43, already described. As the parts reach their other limits of movement the switches 43 and 42 are raised successively, corresponding in their action to that of switches 44 and 45 as the nut 58 approaches its right hand limit, as already described.

The skip 10, which is now approaching the bottom, opens the bin gate 70 in the last part of its downward movement. From this point the cycle above described is repeated continuously as long as any material is left in the supply bin 71, then it automatically stops.

Considerable energy is required to start the movement of the skips, and considerable energy must be disposed of in order to stop such movement. The following scheme is provided to take care of this economically. Located between the rails of the track 12 at the bottom is a hook 92, which can slide in suitable guide rails lengthwise of the track 12. This hook extends upward from the track into the path of some suitable projecting part of the skip, such as one of the axles or a hook 93 firmly fastened to the body of the skip. The sliding hook 92 is attached by a sturdy cable 94 to a circular sheave 95, the cable 94 extending over one or more pulleys 96 to a convenient location for such sheave 95. The circular sheave 95 is mounted on the same shaft or otherwise firmly connected to a spiral sheave 97, on the periphery of which is a cable 98 attached to a heavy weight 99. When either skip approaches the end of its downward movement, the hook 93 on such skip engages the sliding hook 92 and swings the cable 98 around the spiral sheave 97, thus raising the weight 99 and storing energy in it. Because of the spirality of the sheave 97, the weight 99 is started on its downward movement comparatively slowly, and gradually increases in speed. In other words, the mechanical advantage of the skip on the weight is decreased as the weight moves upward. The weight thus assists in bringing the skip to a standstill, this action being effected because of the spiral sheave 97, without any violent jerks on the mechanism or any

undue strains on the cables 94 and 98. The energy stored in the lifted weight 99 is returned to the skip when the latter starts on its upward movement, thus releasing the motor 20 of some of its starting load. The rate at which this energy is returned to the skip is a gradually decreasing one, thus relieving the starting load on the motor 20 mostly at the beginning of the movement of the latter and gradually decreasing as the motor and skips gain in speed and the extra starting load diminishes.

If at any time during the operation of the system, the operator desires to take control, he may do so by manipulating the master switch 40 or auxiliary switch 41. If the skips are at their limits of movement, and the traveling nut 58 is at one of its limits of movement, the motor may be started by throwing the reversing switch 46 to the position opposite to that in which it is found. This produces the same effect as the closing of the bin gate 70, and the motor accelerates automatically as the nut 58 moves away from its extreme position. It is not necessary that the skips be in their extreme positions in order to reverse their directions of movement, for, by the use of the reversing switch 46, the movements of the skips may be stopped at any point in their upward and downward movements and reversed at will. If the motor is in motion and it is desired to stop the skips, the master switch 40 is moved to off position, thus breaking the circuits for the solenoids 36, 37, 38, and 39, and solenoid 26 or 27, whichever one is energized. This interrupts all the normal control circuits and the resultant opening of the reversing switch 23 interrupts the primary circuit of the motor and causes the setting of brake 64. However, if it is desired to stop the operation of the system at any time for any reason whatsoever, it is not necessary to be at the main operating stand to open the master switch 40, for the desired result may be accomplished by opening any one of the emergency switches 41. By opening any one of the switches 41 the cutting of the sections of resistance into the secondary circuit of the motor is first caused, and then the reversing switch 23 is caused to move to its open position, cutting off the current supply to the motor 20. When it is desired to again start up the system, switch 40, if it has been opened, may be closed, blade 47 first coming into engagement with contact 48 for operating switch 23 to connect motor 20 to its supply circuit 21 and then blade 47 engaging blade 49 for causing the gradual cutting out of sections of resistance from the secondary circuit of motor 20. If the master switch has remained closed and either one of the emergency switches has been opened, the emergency switch which has been opened may be closed, contact 41^a of said switch first engaging the elongated contact 41^c for closing the reversing switch 23 for connecting motor 20 to its supply circuit, and then contact 41^b engaging its corresponding contact for causing the gradual cutting out of the sections of resistance in the rotor circuit of the motor 20. When once started the system will at once take up and continue the automatic operation already described, the parts automatically stopping when they reach their limits of movement and starting again when the skip at the bottom becomes sufficiently loaded.

With the arrangement which I have here provided it is not necessary that the skip at the bottom become loaded to a predetermined amount before the bin gate 70 can be closed with the resultant actuation of the master direction switch 54 for making connections for the skip at the bottom to move upward. If it is desired to close the bin gate 70 before the skip at the bottom has received its regular load of a certain predetermined weight, a push button 105 may be operated, completing a circuit from one side of the line 83 through push button switch 105, conductor 106, solenoid 107, to the other side of the supply circuit 83. The resultant energization of coil 107 will draw core 108 with its lever 109 downwardly, removing the latch 76 out of engagement with the finger 73 of the bin gate, permitting weight 72 on the arm 69 to close the bin gate and move the master direction switch to its next forward position for causing the upward movement of the skip at the bottom and the downward movement of the skip located above.

The master switch 40, reversing switch 46, and push button switch 105 are preferably located at the main operation station where the operator may operate any of these switches when it is desired so to do. The emergency switches 41 are to be placed on different floors or at points distant from each other for the purpose of enabling the operator or other proper person who may deem it advisable to open any one of the switches 41 for bringing the system to a state of rest. With the master switch 40, reversing switch 46, and solenoid push button control switch 105 all located at the central point of operation, manual control at such point is rendered convenient, and with the emergency switches 41 located at different points in the system manual control is provided for bringing the system to a state of rest and for again starting said system when it is so desired.

Should the parts already described get out of order or fail to work for any reason, it is possible that the motor will overwind the cable 13 on the drum 14, which might even break the cable. In order to take care of this, a latch 112 is placed in the path of each of the bails 15 slightly beyond the nor-

mal upper limit of movement thereof. In case of overwinding, the bail 15 strikes the latch 112 and moves it in a counter-clockwise direction. This snaps open the switch 113 in the emergency control circuit, which is that of the holding solenoid 25 of the circuit-breaker 22, thus causing the tripping of such circuit-breaker and the breaking of the circuit of the motor 20. This stops the motor. In order to prevent the skip at the top of the hoist from falling in case the cable has been broken by the overwind, the latch 112 at once automatically swings back beneath the cross bars of the bail 15. If the skip starts to drop, this latch will therefore catch the bail and prevent such dropping.

If the cable 13 breaks while the system is in operation, both skips may fall to the bottom of the hoist, the first skip to reach the bottom would open the bin gate 70 and would probably be traveling with so much momentum that due to the impact on the scale platform it would raise the balance beam 77 sufficiently to open a snap switch 114. This switch 114 is also in the emergency control circuit, or that of the solenoid 25, and its opening produces the same results as those produced by the switch 113. The disposition of the switch 114 relative to the weighted beam 77 is such that ordinary operation of the beam, due to the weight of a loaded skip, is not capable of causing actuation of the switch to open position. The nest of springs 80 is for the purpose of preventing the lesser impacts occurring in the ordinary operation of the system, from tripping the latch 76 and the switch 114, for absorbing the last of the momentum of a descending skip, and for giving an ascending skip a kick at starting.

Should the voltage of the main supply circuit 21 fail for any reason while the motor is in operation, the solenoid 66 is immediately deënergized. This causes the setting of the brake 64. If the voltage of the control and supply circuit 83 fails for any reason while the motor is in operation, all of the control circuits will be deënergized. This causes the resistance in the rotor circuit of the motor to be cut in, and the primary circuit of the motor to be broken both at the reversing switch 23 and the circuit-breaker 22.

Any suitable protective means may be provided for protection against the overloads. In case of an overload, in the arrangement illustrated, a series relay 115 opens the circuit of the solenoid 25 and thus causes the opening of the circuit-breaker 22. In some cases the circuit-breaker 22 may be dispensed with and the switches 113, 114, and 115 put in some other suitable circuit.

I have described my hoisting system in what I now consider to be its preferred form. There may be various modifications and arrangements other than those here particularly shown and described, and I aim to cover all such modifications and arrangements of my invention which do not depart from the spirit and scope of my invention as set forth in the following claims.

It is claimed and desired to secure by Letters Patent:

1. In combination, an electric motor, a reversing switch therefor, a controlling switch for said reversing switch, said controlling switch having a plurality of positions and being movable always in the same direction, alternate positions of said controlling switch producing opposite movements of said reversing switch, and a separate switch associated with said controlling switch for reversing the effect of said controlling switch.

2. In combination, a skip, a motor for operating said skip, a reversing switch therefor, a supply bin having a gate for controlling the supply of material to said skip, a controlling switch, means controlled by alternate similar operations of said controlling switch for operating the reversing switch in opposite directions, and separate means for reversing the effect of said controlling switch.

3. In combination, a car movable between predetermined limits of movement, a gate through which material is supplied to the car when at one of its limits of movement, a motor for operating said car, a reversing switch for the motor, a variable resistance for the motor, means independent of said car for causing the closing of said gate for causing the closing of said reversing switch in the proper direction to move the car to the other limit of movement, means for automatically cutting out said resistance, and means controlled by a movement of the car for cutting in said resistance and stopping such movement when such other limit of movement is reached.

4. In combination, a movable car, means for actuating said car, a master switch therefor, a gate through which material is supplied to said car, a direction switch operated automatically by the operation of said gate, manually operated means for reversing the effect of said direction switch, and manually operated means for causing a movement of said gate to operate said direction switch, said master switch and all of said manually operated means being located at a single control point.

5. In a system of control, the combination of a car, means for actuating said car, a master switch therefor, a gate through which material is supplied to said car, a direction switch operated automatically by the operation of said gate, manually operated means for reversing the effect of said direction switch, manu-

ally operated means for causing the movement of said gate to operate said direction switch, and a switch located at a point remote from said master switch and being adapted to stop and start the system at any time while said master switch is closed, said master switch and manually operated means being located at a single control point.

6. In combination, an electric motor, a reversing switch therefor to cause operation of the motor in either direction, means for gradually accelerating said motor subsequent to the closure of said reversing switch, means for controlling the operation of said reversing switch and said accelerating means, said controlling means comprising a control circuit and a switch for determining the direction of rotation of said motor, and means for controlling said direction-determining switch for reversing the effect thereof in any of its operative positions.

7. In combination, a hoist, an electric motor for operating said hoist, a reversing switch for said motor, means automatically operative on the closure of said reversing switch for causing the gradual acceleration of said motor, means for controlling the operation of said reversing switch and said accelerating means, said controlling means comprising a control circuit and a switch for determining the direction of rotation of said motor, means rendered operative by said hoist for actuating said direction switch, and auxiliary means independent of said hoist for controlling the operation of said direction switch.

8. In combination, a skip, an electric motor for operating said skip, a reversing switch for causing operation of said motor and the consequent operation of said skip in either direction, means for controlling the operation of said reversing switch and said motor, said controlling means comprising a control circuit, accelerating and decelerating means associated with said motor and rendered operative through said control circuit at predetermined points in the travel of said skip, a direction switch operative when said skip is at one limit of its travel for controlling said control circuit and said reversing switch to cause operation of said motor in the proper direction, and means rendered operative by said skip when containing a predetermined weight of material for controlling the operation of said direction switch, and auxiliary means operative at the will of an operator for controlling the operation of said direction switch.

9. In combination, a skip, an electric motor for operating said skip, a bin for supplying material to said skip when at one limit of its travel, a gate for controlling the supply of material to said skip, said gate being automatically movable in response to the weight of material in said skip, a reversing switch for closing the circuit of said motor to cause operation thereof and consequent operation of said skip in either direction, means for varying the speed of operation of said motor, means for controlling the actuation of said reversing switch and said speed-varying means, said controlling means comprising a control circuit for said reversing switch and said speed-varying means, and a switch operative to complete said control circuit when said skip is at one limit of its travel, and mechanism rendered operative on movement of said gate toward closed position and effective to cause actuation of said latter switch to complete said control circuit, and auxiliary means effective to cause movement of said gate toward closed position independently of the weight of material in said skip.

10. In combination, a skip, an electric motor for operating said skip, a bin for supplying material to said skip when at one limit of its travel, a gate for controlling the supply of material to said skip, said gate being automatically movable to closed position in response to the weight of material in said skip, a reversing switch for closing the circuit of said motor to cause operation thereof and consequent operation of said skip in either direction, a variable resistance in the circuit of said motor, means for controlling the actuation of said reversing switch and the variation of said resistance to cause acceleration and deceleration of said motor, said controlling means comprising a control circuit for said reversing switch and said resistance-varying means, and a direction-determining switch operative to complete said control circuit when said skip is at one limit of its travel, and mechanism rendered operative on closure of said gate and effective to cause actuation of said direction-determining switch to render said control circuit operative to cause operation of said skip in the desired direction, and a reversing switch for reversing the effect of said direction switch in any of its operative positions and said control circuit to cause operation of said motor in the reverse direction.

Milwaukee, Wisconsin, December 1, 1916.

In testimony whereof the signature of the inventor is affixed.

RAY C. NEWHOUSE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."