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J. D. IHLDER.

ELECTRIC CONTROLLING SYSTEM.

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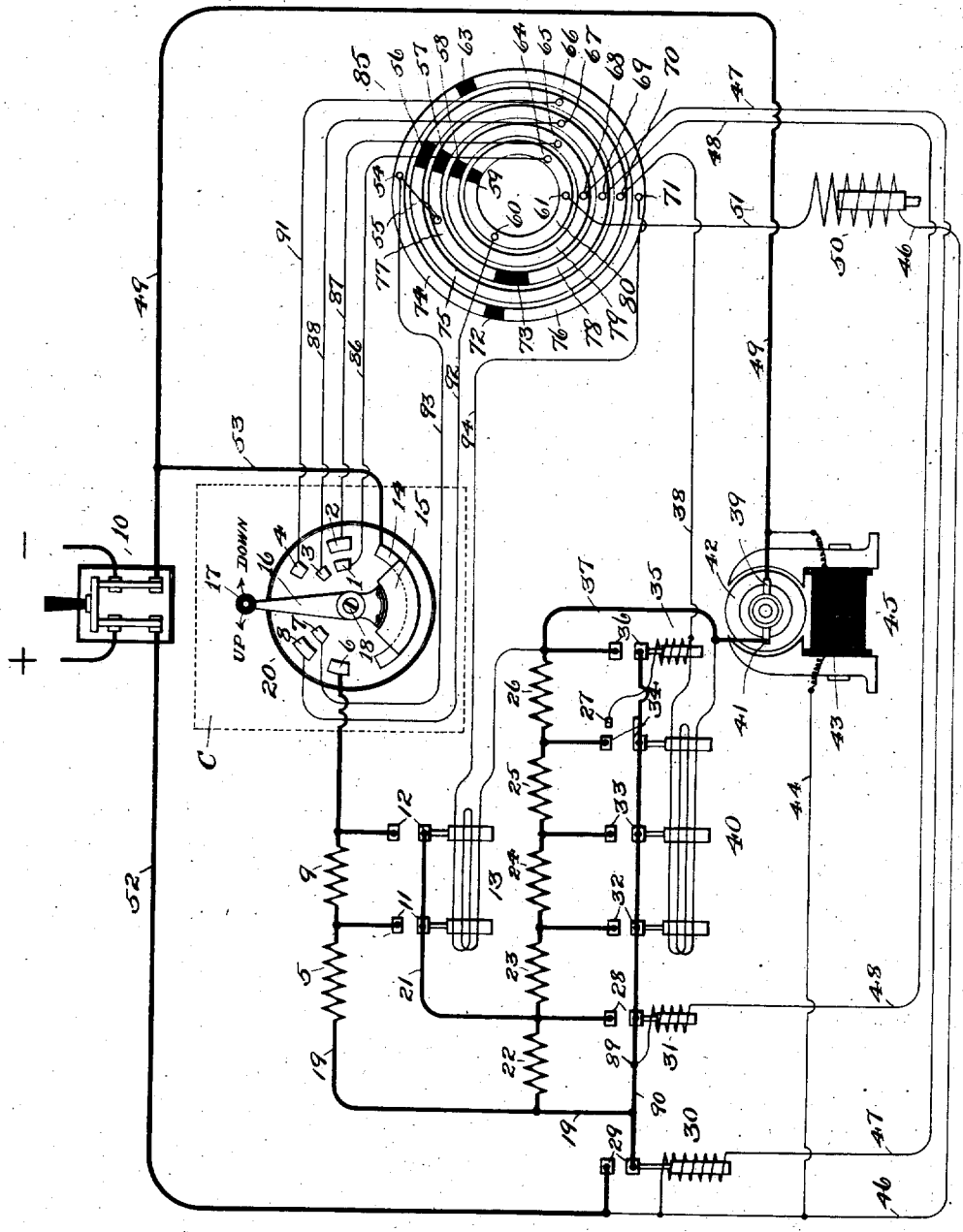

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ELECTRIC CONTROLLING SYSTEM.

No. 897,537. Specification of Letters Patent. Patented Sept. 1, 1908.

Application filed July 29, 1905. Serial No. 271,777.

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented a new and useful Improvement in Electric Controlling Systems, of which the following is a specification.

My invention relates to motor-controlling apparatus and particularly to motor-controlling apparatus used in connection with hoisting apparatus.

One of the objects of my invention is the provision of simple and efficient means for automatically slowing down the speed of the car or carrier as it approaches its upper limit of travel and electrically holding the same at that point through the action of the electric motor connected to drive the hoisting apparatus.

A further object of the invention is to provide means for automatically reducing the speed of the car or carrier as it approaches a predetermined point in its travel and varying such reduction in speed in accordance with the load, said means comprising the starting resistance.

Other objects of the invention will appear hereinafter, the novel combination of elements being set forth in the claims.

Referring to the accompanying drawing which represents more or less diagrammatically an electric hoisting system embodying my invention, 10 designates the main line switch connecting the apparatus to the source of current supply designated by the characters + and −.

20 designates a manually operable switch which is adapted to be placed in the car C or it may be fixed adjacent the hoisting engine. The hoisting motor 45 has its armature 42 connected in series with the main lines 52 and 49 through the brushes 41 and 39. The field 43 of the motor is connected in shunt to the constant potential mains by means of the wire 44. The armature circuit is normally open at the contacts 29 but may be closed by means of the magnet 30 through the starting resistances 22, 23, 24, 25 and 26. The accelerating magnet 40 is arranged to operate the contacts 32, 33 and 34 to successively short-circuit the resistances 23, 24 and 25. The slow-speed magnet 31 operates the contacts 28 to control the resistance 22 while the fast speed magnet 35 with the contacts 36 controls the resistance 26.

13 designates the load magnet which operates the contacts 11 and 12 to short-circuit the load resistances 5 and 9. The contacts 11 and 12 are connected by wire 21 with resistances 22 and 23, and the resistances 5 and 9 are connected to the contact 6 of the manual switch 20 and by wire 19 to the lower one of the contacts 29.

85 is an automatic stop-motion switch comprising a number of circularly-shaped contact strips such as 74, 75, 77, 79 and 80, with insulating sections 72, 73, 56, 57, 58, 59 and 63. The circular strips or conductors are mounted on some insulating material, as slate, and the whole is rotatably mounted, preferably by sprocket and chain in connection with some moving part of the hoisting engine.

Adjacent the movable strips are the fixed contacts 54, 55, 60, 61, etc., which are arranged to bear against and make contact with the circular conductors.

The electric brake 50 is shown connected by wire 46 between the positive main 52 and the brush 61 of the stop-motion switch.

The various parts having been thus pointed out in general, their function and operation will now be fully described.

Assuming the main switch 10 to be closed, as shown, let the lever 16 of the manual switch 20 be moved to the left to cause the car to move upwardly. The contact strip 14 is connected to the negative main 49 and is always in contact with the segment 15 of the switch. The segment 15 is rigidly connected to the lever 16 which is pivoted at 18 to the insulating base and provided with a handle 17 of insulation. In addition to the contact strip 14 on the base are the fixed contacts 1, 2, 3 and 4 at the right and the contacts 6, 7 and 8 at the left. The contacts 1 and 2 are connected by means of the wires 86 and 87 to the contact brushes 64 and 65, which engage the circular conductors 80 and 79, respectively, of the automatic stop-motion switch 85. The brushes 64 and 65 are respectively in electric connection with the brushes 61 and 68 which in turn are connected by the wires 51 and 47 to the coil of the brake 50 and to the coil of the main line magnet 30. Therefore when the lever 16 is moved toward the left to go up as indicated

the segment 15 will first electrically connect the contacts 1 and 2 whereupon the magnet 30 and brake 50 will be operated, the one to close the motor-armature circuit through the contacts 29 and the resistances 22, 23, etc., and the other to release the brake against the action of a spring which applies it. The circuit for the main line magnet 30 may be traced from the positive main through the wire 52, coil of magnet 30, wire 47, brush 68, contact strip 79, brush 65, wire 87, contact 2, segment 15, contact strip 14, wires 53 and 49 to the negative main. The circuit through the brake magnet coil is parallel to the coil of magnet 30 from the wire 52, through the wire 46, coil of magnet 50, brush 61, strip 80, brush 64, wire 86, contact 1 and segment 15. The circuit through the motor-armature is from the wire 52 to and through the contacts 29, wire 19, starting resistances 22, 23, 24, 25 and 26, wire 37, motor-armature brush 41, armature 42, brush 39, wire 49, to the negative main. The shunt field is also completed through the wire 44 when the main line switch 10 is closed, so that now the motor can start and attain a predetermined slow speed. On moving the handle 17 of switch 20 farther toward the left the contact 3 is engaged by the segment 15. This completes a circuit from the positive main through wire 52, to and through the contacts 29, wire 90, coil of slow-speed magnet 31, wire 48, contact brush 69, strip 78 of the automatic stop-motion switch, brush 67, wire 88, contact 3, segment 15, wires 53 and 49 and thus to the negative main. The magnet 31 is therefore connected across the constant potential mains, as is magnet 30, and operates to close the contacts 28 and short-circuit the resistance 22. The motor will thereupon receive more current and run at full slow speed.

The next operation is the placing of the handle 17 of the switch 20 in its extreme left-hand position so that the segment 15 will engage the fixed contact 4 in addition to the contacts 1, 2 and 3. A circuit will now be completed from the positive main to and through the wire 52, contacts 29, wire 90, contacts 28, resistances 23, 24, 25 and 26, wire 37, coil of accelerating magnet 40, wire 38, brush 70, strip 75, brush 66, wire 91, contact 4, segment 15, strip 14, wire 53 to the negative main. Thus the accelerating magnet 40 is connected directly across the motor-armature and will operate automatically to cut out or short-circuit the starting resistances 23, 24 and 25, consecutively, in a well-known manner, depending upon the load on the motor. The contacts 32, 33 and 34 are closed successively but when the last are closed the wire 90 is connected through contact 27 to and through the coil of fast-speed magnet 35 to the wire 38. Upon the energization of this magnet 35 the contacts 36 are closed and the resistance 26 short-circuited. The current can now flow directly from wire 90, through wire 37 to the motor-armature. The motor-armature is therefore connected directly across the mains and will run up to fast speed. The stop-motion switch 85 being positively connected to rotate in harmony with the motor will move in a clockwise direction as soon as the car starts upwardly. As the car approaches its upper limit of travel, the first operation of the switch 85 will be to break the circuits of the fast-speed magnet 35 and the accelerating magnet 40. This is caused by the insulating section 56 running under the brush 66. This will operate to place the resistances 23, 24, 25 and 26 in the motor-armature circuit and therefore slow down the motor. Very shortly after this operation, the insulating section 57 runs under the brush 67 to break the circuit including the magnet 31. The contacts 28 therefore become separated and the resistance 22 reinserted to still further reduce the speed of the motor. All the starting resistances having been replaced in the motor-armature circuit, the motor will run at a very slow speed. In connection with an ammunition hoist or a furnace hoist I preferably limit the rotation of the circular stop-motion switch 85 so that the car will be stopped against a buffer at the extreme upper limit of its travel and held there by the action of the motor. This is accomplished by stopping the automatic stop-motion switch with brushes 66 and 67 on the insulation sections 56 and 57, respectively, and the brushes 64 and 65 in contact with the strips 80 and 79, respectively. The brake magnet 50 and main line magnet 30 are therefore kept energized but since the current must traverse the starting resistances it will be insufficient to injure the armature by heating but will produce sufficient torque to hold the car against its buffer. If desired, however, the automatic stop-motion switch may be rotated a little farther so that the insulating sections 58 and 59 shall run under the brushes 65 and 64, respectively, to automatically deënergize the brake-magnet 50 and main line magnet 30 to stop the car before it reaches its extreme upper limit. When it is desired to lower the car or carrier the switch handle 17 is brought back to its central position as shown in the drawing. This will cause the brake to be applied, as the circuit to the magnet 50 is broken at the contact 1. Furthermore, the circuit of magnet 30 is interrupted at the contact 2 and therefore the contacts 29 are opened. The current to the motor is thus cut off but the car is kept from descending by means of the brake which is now applied since the magnet 50 is deënergized.

I will now describe my automatic means for controlling the speed of lowering the car or carrier or for slowing down the movement

of the carrier and stopping same at its lower limit of travel.

On moving the handle 17 to the right the contact segment 15 will engage with the fixed contacts 6, 7 and 8. When the segment 15 is brought into connection with the contact 6, a local circuit including the motor-armature, the starting resistances and the additional resistances 5 and 9, is closed. It will be seen that the contacts 6, 7 and 8 are so arranged that this local circuit is established before the segment 15 engages the contacts 7 and 8. It should be noted that when the car is at its upper limit of travel the automatic stop-motion switch 85 has revolved nearly 90° in a clockwise direction from the position shown but that the brushes 60 and 61 still remain in contact with the strip 80. Therefore, when the segment 15 engages contact 8 the brake magnet 50 is energized and the brake consequently released. The circuit thus established is as follows: from the positive main through wire 52, to and through wire 46, coil of magnet 50, brush 61, strip 80, brush 60, wire 92, contact 8, segment 15, strip 14, wire 53, wire 49, and switch 10 to the negative main. The contact 7, however, temporarily remains deenergized since it is connected to the brushes 54 and 55 which are in contact with strips 74 and 77 insulated by the insulation sections 72, 63 and 73, 57, respectively. The brake having been released the car can descend by reason of its own load and in doing so drives the motor-armature backwards. Since the field 43 is connected across the main lines by wire 44, the same will be fully excited and the armature being driven by the load will generate a current through the various resistances forming a closed circuit with it. This arrangement constitutes an electro-dynamic brake and prevents excessive speed of the car or carrier as it descends. As soon as the car starts in its downward travel the automatic stop-motion switch 85 will be slowly turned in an anti-clock-wise direction through nearly 180° by the hoisting machinery. After the car has traveled a predetermined distance the slow-down operation is automatically controlled by means of said stop-motion switch. The first change will take place when the insulation section 57 runs under and past the brush 55 so that the brushes 55 and 69 will be electrically connected by the strip 78. The slow-speed magnet 31 will then be connected in shunt to the load resistances 5 and 9, the circuit being as follows: from wires 19 and 90 to and through coil of magnet 31, wire 48, brush 69, strip 78, brush 55, brush 54, wire 93, contact 7, segment 15, and contact 6 to the other side of the load resistances 5 and 9. The combined load resistances are preferably greater than the combined accelerating resistances so that the energization of the magnet 31 shall depend on the potential across the load magnet resistances 5 and 9. This potential varies directly as the speed of the motor-armature and consequently of the car. If the speed rises above a predetermined point the magnet 31 will be energized to short-circuit the resistance 22 by the closure of the contacts 28. The resistance in the armature circuit being thus decreased more current can flow and the electro-dynamic braking action will be increased. The car will therefore run at a predetermined speed. The automatic stop-motion switch in revolving still farther brings the insulation section 63 under and past the brush 54 so that the latter will be in contact with the strip 76. This occurs when the car is a short distance from its lower limit of travel. The load magnet 13 is now connected directly across the motor-armature from the brush 41 and wire 37 to the coil of magnet 13, through wire 94, brush 71, strip 76, brush 54, wire 93, contact 7, segment 15, strip 14, wire 53, wire 49, to the other motor-armature brush 39. The load magnet will be energized to a degree depending upon the speed of the motor, to close one or both of its contacts 11 and 12 which operate to cut out or short-circuit the load resistances 5 and 9. There is thus provided a means for automatically slowing down or reducing the speed of the motor as the car approaches its lower limit of travel and varying such reduction of speed in accordance with the load. The next operation is the application of the brake to stop the car substantially at the same point regardless of the load. This occurs when the insulation section 59 runs under the brush 60 to interrupt the circuit of the brake magnet and therefore allowing the brake to be applied. It should be noted that the brake magnet can again be energized for the reason that another brush 64 is still in electrical connection with the brake magnet so that the latter may be energized by moving the handle 17 to the left to bring the segment 15 and contact 1 into engagement.

In reviewing the operation of the system it will be seen that when it is desired to raise a load the brake is first released and current admitted to the motor through the starting resistances. Then a portion of the starting resistance is short-circuited by means of the slow-speed magnet which causes a somewhat higher speed. The accelerating magnet is then energized to automatically short-circuit other resistances in proportion to the load, and finally the fast-speed magnet operates to cut out all the resistances if the load is light.

As the upper limit of the car's travel is approached the current to the motor is automatically reduced to such an amount that the car will be brought gently against the buffer at the top and be held there by the motor, the brake being kept in its releasing position. Upon moving the manual switch,

however, to its central position, the brake is applied to hold the car at its upper limit of travel.

To lower the car the handle 17 is turned toward the right to cause the brake to be raised to releasing position. The motor is then turned backward by the load and becomes a dynamo generating current through the starting resistances and the load resistances which are together in series with the motor armature. Toward the lower end of travel of the car a portion of the starting resistance may be short-circuited depending upon the speed of the car. Shortly afterward the load magnet is shunted across the armature, said magnet operating to cut out the load resistance in proportion to the speed and load of the descending car. Finally, the brake is applied to stop the car at substantially the same point with varying loads.

Having thus fully described my invention and without limiting myself to the precise construction of details and arrangement of parts as herein shown, but reserving the right to vary the same in accordance with the spirit and scope of my invention, what I claim and desire to have protected by Letters Patent of the United States is:

1. The combination with an elevator car and its motor, of sectional starting resistance, an electro-dynamic brake circuit including said resistance, means for controlling said resistance in accelerating the motor, and means co-acting with said controlling means for automatically cutting out a portion of said resistance when in the electro-dynamic brake circuit.

2. The combination with an elevator car and its motor, of sectional starting resistance, means for controlling said resistance in gradually starting the car on the up motion, automatic means controlling said resistance to reduce the speed of the motor while the car is approaching its upper limit of travel, and means for establishing an electro-dynamic brake circuit including said resistance for regulating the speed of the car in its downward travel.

3. The combination with a car and its motor, of starting resistance for the motor, electro-magnetic means for controlling said resistance, a stop-motion switch for automatically re-inserting said starting resistance when the car approaches the upper limit of its travel, a manual switch for establishing an electro-dynamic brake circuit including said starting resistance, and circuits and connections co-acting with said stop-motion switch for automatically cutting out a portion of said resistance as the car approaches its lower limit of travel.

4. The combination with an elevator car, and its motor, of sectional starting resistance for said motor, electro-magnetic means for controlling said resistance, an additional sectional resistance, a load magnet for controlling said additional resistance, means for connecting both of said resistances in an electro-dynamic brake circuit, and means for automatically effecting the energization of said load magnet as the car approaches a predetermined point in its downward travel.

5. The combination with an elevator car and its motor, of sectional starting resistance for said motor, automatic means for controlling said resistance, additional sectional resistance, means for connecting both the said resistances in an electro-dynamic brake circuit, a load magnet for controlling said additional resistance, and means for connecting said load magnet across the motor-armature as the car approaches the lower limit of its travel.

6. The combination with an elevator car and its motor, of starting resistance therefor, means for controlling said resistance, additional resistance, means for closing a local circuit including the motor-armature and said resistances, and automatic means for reducing the speed of the motor, and varying such reduction of speed in accordance with the load.

7. The combination with an elevator car and its motor, of starting resistance therefor, controlling means for said starting resistance, an additional resistance, means for establishing an electro-dynamic brake circuit including both the said resistances, and automatic means for establishing a circuit in parallel to said additional resistance to effect the operation of a part of said controlling means to cut out part of said starting resistance in the electro-dynamic brake circuit as the car approaches a stopping point.

8. The combination with an elevator car and its motor, of sectional starting resistance for said motor, electro-magnetic means for controlling a portion of said starting resistance, an electro-magnet for controlling another portion of said starting resistance, additional sectional resistance, means for establishing a motor-circuit including the motor-armature and both of said sectional resistances, a load magnet for controlling said additional sectional resistance, automatic means for placing said last-named electro-magnet in parallel with the said additional resistance to effect the cutting out of said another portion of the starting resistance as the car approaches a pre-determined stopping point, and for also connecting said load magnet across the motor-armature for cutting out one or more sections of said additional resistance, depending upon the speed of travel of the car.

9. The combination with an elevator car and its motor, of sectional starting resistance for said motor, an electro-magnetic main line switch, a slow speed electro-magnetic switch for cutting out additional portions of said

starting resistance, a fast speed magnetic switch controlled by said accelerated magnet switch for cutting out the last portion of said starting resistance, a brake magnet, a manual switch for controlling said electro-magnetic switches and said brake magnet, a stop-motion switch for effecting the re-insertion of said starting resistance as the car approaches the upper limit of its travel, an additional sectional resistance, circuits and contacts co-acting with said manual switch for connecting both of said sectional resistances in an electro-dynamic brake circuit, a load magnet for controlling said additional resistance, and circuits and connections co-acting with said stop-motion switch for placing a slow speed magnet across said additional sectional resistance as the car approaches the lower limit of its travel, and thereafter connecting the load magnet across the motor-armature to reduce the speed of the car in proportion to the load, and for finally interrupting the brake magnet circuit to effect the stopping of the car at its lower limit of travel substantially at the same point with varying loads.

10. The combination with a car and its motor, of motor-controlling means, and circuits and connections so constructed and arranged that as the car approaches the upper limit of its travel the speed of the same shall be automatically reduced and the said car held at the upper limit by said motor.

11. The combination with a car, of electrical means for hoisting same, and means for reducing the current through said motor as the car approaches the upper limit of its travel but allowing sufficient current to flow through said motor to cause the same to hold said car at said upper limit.

12. The combination with a car, of electrical means for hoisting same, and means for automatically reducing the current through said motor as the car approaches the upper limit of its travel but allowing sufficient current to flow through said motor to cause the same to hold said car at said upper limit.

13. The combination with a car and its motor, of motor-controlling means, and circuits and connections so constructed and arranged that the motor shall be automatically reduced in speed as the car approaches its upper limit and be maintained sufficiently energized to hold said car at its upper limit.

14. The combination with an elevator car or carrier, of a motor for hoisting said car, and means for automatically reducing the speed of said car as the same approaches its upper limit of travel and maintaining said motor sufficiently energized to hold said car against its upper limit stop.

15. The combination with a car and its motor, of motor-controlling means comprising resistances in circuit with said motor, and means for varying said resistance so that as the car approaches the upper limit of its travel and the motor is taking power the car shall be automatically reduced in speed and held by said motor at said limit, and so that as the car approaches the lower limit of its travel and the motor is being driven as a generator said car shall then also be automatically reduced in speed.

16. The combination with a car and its motor, of motor-controlling means comprising resistances in circuit with said motor, and means for automatically cutting out said resistances as the car starts upwardly and to throw in said resistances as the car approaches its upper limit of travel but maintain the motor circuit so that sufficient current shall flow through said motor to cause the same to hold the car against its upper limit stop.

17. The combination with a car and its motor; of motor-controlling means comprising resistance in circuit with said motor, means for short-circuiting said resistance as the car starts from or approaches the lower limit of its travel, and means for short-circuiting only a part of said resistance should the car descend too rapidly.

18. The combination with a car and its motor, of motor-controlling means; and circuits and connections so constructed and arranged that the car shall be hoisted, have its speed automatically reduced as it approaches its upper limit of travel, and be held at said limit, by said motor; and that the car shall descend by reason of its own load and automatically reduced in speed as the car approaches the lower limit of its travel, said last mentioned reduction of speed being in proportion to the load.

19. The combination with a car and its motor, of motor-controlling means, and circuits and connections so constructed and arranged that the car shall be gradually and automatically reduced in speed as it approaches its upper limit of travel and be held at said limit by the motor and so that the speed of the car shall be gradually and automatically reduced as it approaches its lower limit and such reduction of speed varied in accordance with the load.

20. The combination with a car and its motor, of motor-controlling means comprising resistance in circuit with the motor-armature and means for automatically varying said resistance during the travel of the car, circuits and connections so constructed and arranged that as the car approaches its upper limit its speed shall be automatically reduced and the car held against its upper limit stop, and means for automatically reducing the speed of the car as it approaches its lower limit and varying such reduction of speed in accordance with the load.

21. The combination with a car and its motor, of motor-controlling means compris-

ing resistance in circuit with the motor-armature, and means for gradually and automatically varying said resistance as the car starts from its lower limit and as it approaches its upper limit of travel, additional resistance in circuit with said first-named resistance, and means for automatically varying said additional resistance in proportion to the load as the car approaches its lower limit of travel, so that the car shall be gradually and automatically reduced in speed and stopped at substantially the same point regardless of its load, and circuits and connections so constructed and arranged that the car shall be held by the motor at its upper limit of travel and that the motor shall be driven as a generator as the car descends to furnish current to said automatic means for reducing the speed of the car.

22. The combination with a car and its motor, of resistance in circuit with the motor-armature, means for varying said resistance, additional resistance in circuit with said first-named resistance and additional resistance-varying means therefor, an automatically rotatable switch, a manually operable switch, and circuits and connections so constructed and arranged that when the manual switch is in one position circuits to said first-named current-varying means shall be closed and automatically controlled by said automatic switch so that the car shall be automatically reduced in speed as it approaches its upper limit of travel and held by the motor against its upper limit stop and when the manual switch is in another position circuits including a local circuit through the motor-armature and said resistance shall be closed so that as the car descends by reason of its own load said motor shall act as a generator to retard the downward movement of the car, and so that as the car approaches its lower limit of travel said automatically rotatable switch shall close a circuit to said second-named resistance-varying means to cause the car to be gradually reduced in speed and stopped at substantially the same point independent of the load.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN D. IHLDER.

Witnesses:

GUFFIT L. JOHN,

D. L. HOWSON.