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J. E. BOYCE.

ELEVATOR BRAKE.

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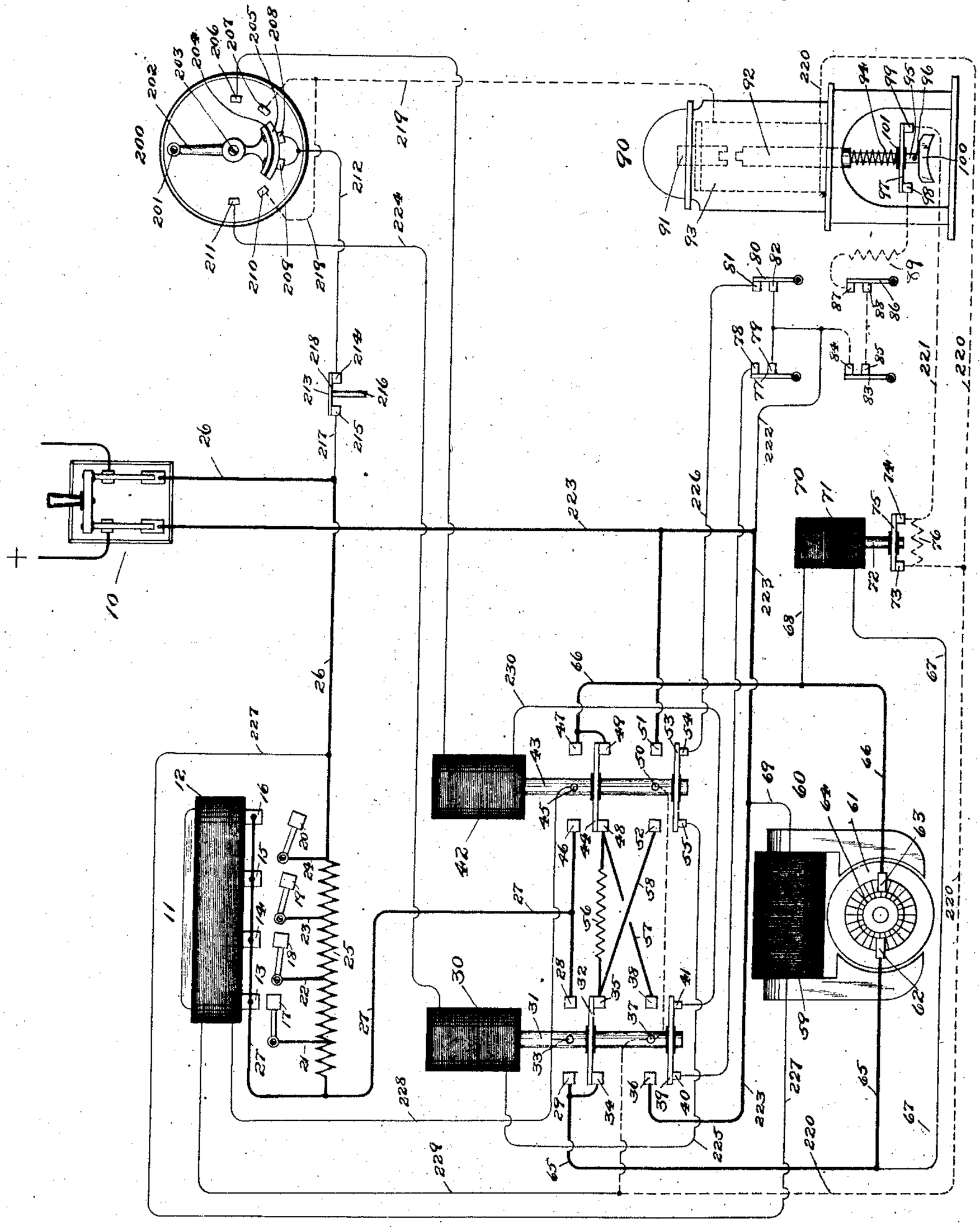

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ELEVATOR-BRAKE.

No. 814,669. Specification of Letters Patent. Patented March 13, 1906.

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To all whom it may concern:

Be it known that I, JOHN E. BOYCE, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Elevator-Brakes, of which the following is a specification.

My invention relates to electric brakes, and has for its object to provide a brake which is automatically operated so as to produce a gentle or powerful braking effect according to circumstances and which is also under the direct control of the operator.

In the accompanying drawing I show my invention as applied to an electric-elevator system. The heavy lines designate the main or motor circuits, the light lines the operating and shunt-field circuits, and the broken lines designate the brake-circuits.

10 designates a main-line switch which connects the system to the source of supply designated by + and −.

11 is a magnet, which may be energized by a coil 12.

13, 14, 15, and 16 are poles of the magnet directly under which are movable armatures carrying contacts 17, 18, 19, and 20, which are so arranged that when acted upon by the magnet 11 they will be pulled up against and make contact with the poles 13, 14, 15, and 16, respectively. These movable contacts may be located at different distances from the contact-poles 13, 14, 15, and 16 in order that as the strength of the magnet increases it will pull up the pivoted armatures at different times, so that if the starting resistance 25 is connected to them, as shown, it may be short-circuited in successive steps. The negative main may be connected to one side of this starting resistance by a wire 26 and the other side to the armature 61 of a motor 60 by a wire 27 through a reversing-switch which will now be described. The coils 30 and 42 are adapted when energized to raise their respective cores or plungers 31 and 43, which carry insulated contact-plates 32 and 39 and 44 and 53, respectively. When the plunger 31 is in the position shown in the drawing, the contact-plate 32 bridges the stationary contacts 34 and 35 and the contact-plate 39 connects the stationary contacts 40 and 41. In a similar manner the contact-plates 44 and 53 connect the stationary contacts 48 49 and 54 55, respectively. Upon the energization of the coil or solenoid 30 its core or plunger 31 and the plates 32 and 39, secured to it are lifted until the said plates electrically connect the contacts 29 33 28 and 36 37 38, respectively. In a similar manner when the plunger 43 is lifted and its contact-plate 44 establishes an electrical connection between the contacts 46 45 47 and at the same time its contact-plate 53 connects the contacts 52 50 51. Between the contacts 35 and 48 a comparatively low resistance 56 may be provided, which is so arranged as to be thrown in series with the motor-armature in a local circuit when the motor is being brought to rest.

It will be seen by tracing the various circuits through these two magnetically-operated switches that when the core 31 is raised certain circuits are closed and current will flow through the motor-armature in one direction and that when the core 43 is raised current will flow through the motor-armature in the opposite direction, so that this constitutes a reversing-switch by which the direction of rotation of the armature may be controlled.

60 represents a motor, 59 its shunt-field, and 61 its armature.

62 and 63 are the brushes which rest on the commutator 64.

70 is a magnet connected across the brushes 62 and 63 of the motor-armature by the wires 67 65 and 68 66, respectively. This magnet is provided with a plunger 72, which carries at its lower end the insulated contact-plate 75. This contact-plate normally connects the stationary contacts 73 and 74 together—that is, when the coil 71 is not energized. A resistance 76 is connected across the contacts 73 and 74, and this is short-circuited when the plate 75 connects the contacts 73 and 74. To the right of the magnet 70 are shown limit-switches, which are intended to be opened when the car reaches the upper or lower limits of its travel. They comprise pivoted arms 77, 80, 83, and 86. These arms normally connect the contacts 78 and 79 81 and 82 84 and 85 87 and 88, respectively. 89 designates a resistance.

The brake-stand 90 incloses a magnet-solenoid 93, plunger 92, and pole-piece 91. To the lower end of this plunger 92 is fastened a rod 95, on which slides a contact-plate 97,

which is insulated from the rod by the insulation 101. 96 is a stop-pin which limits the downward movement of the contact-plate 97 on the rod 95. 94 is a compression-spring surrounding a portion of the rod 95, and 100 is the brake-shoe, which is adapted to engage with some revolving part of the elevator machinery. It may be applied in the usual way by means of a spring or weight. Directly under the contact-plate 97 are shown two stationary contacts 98 and 99. These contacts are electrically connected by the contact-plate 97 when the plunger 92 is in the position shown in the drawings—that is, when the brake is applied to stop the motion of the elevator machinery.

200 designates a manually-operable control-switch which way be located in the elevator-car.

201 is the operating-handle; 202 a lever pivoted at 203 and carrying the contact-piece 205, which is insulated from the lever by means of the insulation 204. When the handle 201 is moved from its central position to the left or right, the contact-piece 205 bridges the stationary contacts 206, 207, and 208 or 209, 210, and 211.

213 designates a switch in which the stationary contacts 214 and 215 are normally connected by the contact-plate 218, but which may be arranged to break the circuit between these contacts whenever the hoisting-cable becomes slack.

The operation of this device is as follows: If the operator move the lever 202 to the right, the movable contact 205 will bridge the fixed contacts 209 and 210, and a circuit will be established between the negative main 26, through the wire 217 and slack-cable switch 213, wire 212, contact-piece 205, wire 219, through the brake-coil 93, from here by wire 220 to the contact 73, through contact-plate 75 to contact 74, by wire 221 to contact 99, contact-plate 97, contact 98, through the resistance 89 to contact 87, from there to contacts 88 85 84, and by wire 222 to the positive main 223. Thus a circuit has been established from the positive main to the negative main, including the brake-magnet 93 and resistance 89. This resistance 89 is so proportioned that it limits the current in the brake-coil to an amount that is just sufficient to slightly ease off the brake, but is not enough to raise the brake-shoe 100 sufficiently to allow the elevator mechanism to start in motion—that is, the brake is still applied, but not with its full power. Now if the operator move the handle 201 to its extreme right-hand position the contact-piece 205 will bridge the contacts 209, 210, and 211. Current will now flow from the positive main through wires 223 224, the limit-switches 77 and 80, wire 226, contacts 54 55, and contact-plate 53, wire 225, solenoid 30, wire 224, contact 211, contact-piece 205, contact 209, wire 212, slack-cable switch 213, and wires 217 26 to the negative main. This operation will excite the magnet 30, which will draw its plunger 31 upwardly until the lower contact-plate 39 bridges the three contacts 36, 37, and 38. The contact 36 is connected to the positive main by the wire 223, so that current now flows from wire 223 to contact 36, contact 37, wire 220, to the brake-magnet 93. This last operation short-circuits the resistance 89, so that the brake-magnet will receive current at the full potential of the supply. It then raises the brake-shoe 100 and lifts the engagement-plate 97 out of contact with the contacts 98 and 99. When the magnet 30 raises its plunger 31, as has been described, the contact-plates 39 and 32 connect the contacts 36 37 38 and contacts 29, 33, and 28, respectively. Circuits will thus be closed through the motor, and it will tend to revolve in a certain direction. The starting-resistance 25 is arranged to be cut out automatically by the magnet 11, which is shown connected in a well-known manner. When the contact-plate 39 is raised, it breaks the connection between the contacts 40 and 41 and opens the circuit to the coil 42 through the wire 230, thus preventing the magnet-coils 30 and 42 from being both energized at the same time. In a similar manner when the plunger 43 is up the circuit to magnet-coil 30 and wire 225 is broken at the contacts 54 55. The shunt-field 59 of the motor may be connected across the mains by the wires 69 and 227. Should the operator move the operating-lever 202 to the left, the system would go through the same operations, except that in this case the coil 42 would be excited and the plunger 43 raised. The contact-plates 44 and 53 would be raised, so that they would bridge their respective contacts 46, 45, and 47 and 52, 50, and 51, respectively. This would establish such circuits through the motor that it would revolve in the opposite direction. The solenoid 71 is connected in shunt to the motor-armature, so that when the reversing-switch last operated is restored to its normal position and the motor is acting as a generator it shall be sufficiently energized to lift its plunger 72 and throw the resistance 76 in series with the brake-magnet solenoid 93. When the motor slows down to a predetermined speed, the plunger 72 is dropped and the resistance 76 short-circuited by the contact-plate 75, coacting with the contacts 73 and 74.

In order to stop the elevator, the operator moves the lever 202 back until the contact 211 is uncovered. The contact-piece 205 bridges the contacts 208, 209, and 210. This operation breaks the circuit to the magnet 30, so that it becomes deënergized and allows the plunger 31 to drop until the contact-plates 32 and 39 bridge the contacts 34 35 and 40 41, respectively. This breaks the

circuit of the magnet 11, which deënergizes it and allows the contacts 17, 18, 19, and 20 to drop back to their original position, which is shown on the drawing, so that the starting resistance is again inserted in the armature-circuit ready for the next start.

When the plunger 31 drops, the contact 37 is disconnected from the contact 36 and main line 223, so that the circuit through the wire 220 to the brake-magnet is opened. The brake-magnet is at once deënergized and its plunger 92 drops until the contact-plate 97 bridges the contacts 98 and 99. A circuit is thereby reëstablished through the brake-magnet, as current will now flow to the same by wire 222 through resistance 89 and 76.

The magnet 70, as already described, is connected across the armature-terminals and depends for its operation on the potential of the revolving motor-armature. As its plunger 72 is raised during the usual running of the motor the contact-plate 75 is lifted from contacts 73 and 74 and the resistance 76 is inserted between the wires 221 and 220. It has already been shown that when the reversing-switch plungers 31 and 43 are down and the contacts 37 and 50, respectively, are disconnected from the positive main 223 the brake-magnet cannot get its supply of current from the positive main by wire 220. It must, therefore, get it through the wire 222. As the circuit through the brake-magnet now includes the resistances 89 and 76, the brake-coil 93 will receive but little current and the brake will be applied with considerable force. As soon, however, as the motor-armature has slowed down a predetermined amount the potential across its brushes and the strength of the magnet 70 will no longer be sufficient to hold its plunger 72 up. The latter will then short-circuit the resistance 76. This will allow more current to flow through the brake-magnet and will ease off the brake slightly—just sufficient to allow the car to come to rest without jar. If the resistance 56 is used, it is connected in a local circuit in series with the motor-armature 64 when both of the plungers 31 and 43 are down. While the armature is rotating the current which it generates flows through this resistance 56, thus producing a load on the motor which acts as an electrodynamic brake which tends to bring the motor to rest. The limit-switch arms 77 and 80 are set to automatically open the circuits of the reversing-switch coils 30 and 42 as the car approaches the limit of its travel. Should they operate, the current would be cut off from the motor and the circuit to the brake-magnet would be opened either at the contact 37 or the contact 50. This would allow the brake to be applied gently in the same way as above described. Upon a further movement of the car the limit switch arms 83 or 86 would open, thus open-circuiting the brake-magnet 93 and applying the brake with maximum force. Should the slack-cable switch 213 operate to open the circuit connected to the controlling-switch 200, all current would be cut off from the brake, and it would be applied with full power.

It will be seen from the foregoing that in all ordinary cases by placing the operating-switch 200 in its intermediate position the car will be brought to rest gently, and for all ordinary stops I prefer to do this way. Should, however, the operator desire to apply the brake with its full power, he may bring the operating-switch 200 to its central position. As the current to the brake-magnet always flows through the wire 219, its cricuit would thereby be broken at contact 210 or 207 and the magnet 93 would be totally deënergized, so that the brake-shoe 100 would be applied with its full power.

When my invention is used, a heavier or stronger brake may be employed than is usual in systems of this character. It will ease itself off automatically if applied in the usual way, so that the mechanism to which it is applied may be brought to rest gently, or it may be applied with full force at once, thus providing an emergency brake. As these operations are entirely under the control of the operator and as he may apply the brake under all conditions, even if other parts of the apparatus fail to work, its advantages are obvious. Another of its valuable features is that by combining it with automatic limit-stops it will prevent another class of accidents which are caused by the driven mechanism overrunning its prescribed limits of movement.

My invention is applicable to other mechanisms than electric elevators, and I do not wish to limit myself to that particular use, as I described it merely to exemplify some of the advantages of the invention.

Instead of the magnet 70 controlling a resistance 76 in one step, as shown, it may be arranged to cut out or short-circuit a series of resistances successively—in some such way, for example, as is illustrated in connection with magnet 11 on the drawing.

What I claim is—

1. The combination with an electric motor, of a brake therefor, and manually-controlled means for applying the brake with full power or with different degrees of power depending upon the speed of the motor.

2. The combination with an electric motor, of an electric brake, and means for automatically easing off the brake as the motor comes to rest.

3. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, and automatic means depending upon the speed of the motor for varying the current in such magnet.

4. The combination with an electric motor,

of a brake therefor, an electromagnet arranged to release said brake, a resistance in series with said magnet, and means depending upon the speed of the motor for automatically short-circuiting the resistance.

5. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, a resistance for said magnet, a source of electrical supply, manually-operable means for connecting said magnet directly to the source of electrical supply or connecting the magnet to the source of supply through the resistance, and means depending upon the speed of the motor for automatically short-circuiting such resistance.

6. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, resistances adapted to be connected in series with said magnet, a source of electrical supply, manually-operable means for connecting the magnet directly to the source of electrical supply or for connecting the magnet to the source of electrical supply through said resistances, and means depending upon the speed of the motor for short-circuiting part of said resistances.

7. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, resistances adapted to be connected in series with said magnet, a source of electrical supply, manually-operable means for connecting the magnet directly to the source of electrical supply or for connecting the magnet to the source of electrical supply through said resistances, automatic means for cutting off all current which flows to the magnet except that which flows through said resistances, and means depending upon the speed of the motor for short-circuiting part of said resistances.

8. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, resistances adapted to be connected in series with said magnet, a source of electrical supply, manually-operable means for connecting the magnet directly to the source of electrical supply or for connecting the magnet to the source of electrical supply through said resistances, automatic means for cutting off the current which flows to the magnet except that which flows through said resistances, means depending upon the speed of the motor for short-circuiting part of said resistances, and additional automatic means for cutting off all current from the magnet.

9. The combination with an electric motor, of a brake therefor, an electromagnet arranged to release said brake, resistances adapted to be connected in series with said magnet, a source of electrical supply, manually-operable means for connecting the magnet directly to the source of electrical supply or for connecting the magnet to the source of electrical supply through said resistances, automatic means for cutting off the current from said magnet except that which flows through the resistances, means depending upon the speed of the motor for short-circuiting one of said resistances, additional automatic means for cutting off all current from said magnet.

In witness whereof I have signed my name in the presence of two subscribing witnesses.

JOHN E. BOYCE.

Witnesses:
W. H. BRADY,
WALTER C. STRANG.